HUNTING AS A CONTROL METHOD FOR WILD PIGS IN HAWAII VOLCANOES NATIONAL PARK

A Report for Resource Management

by

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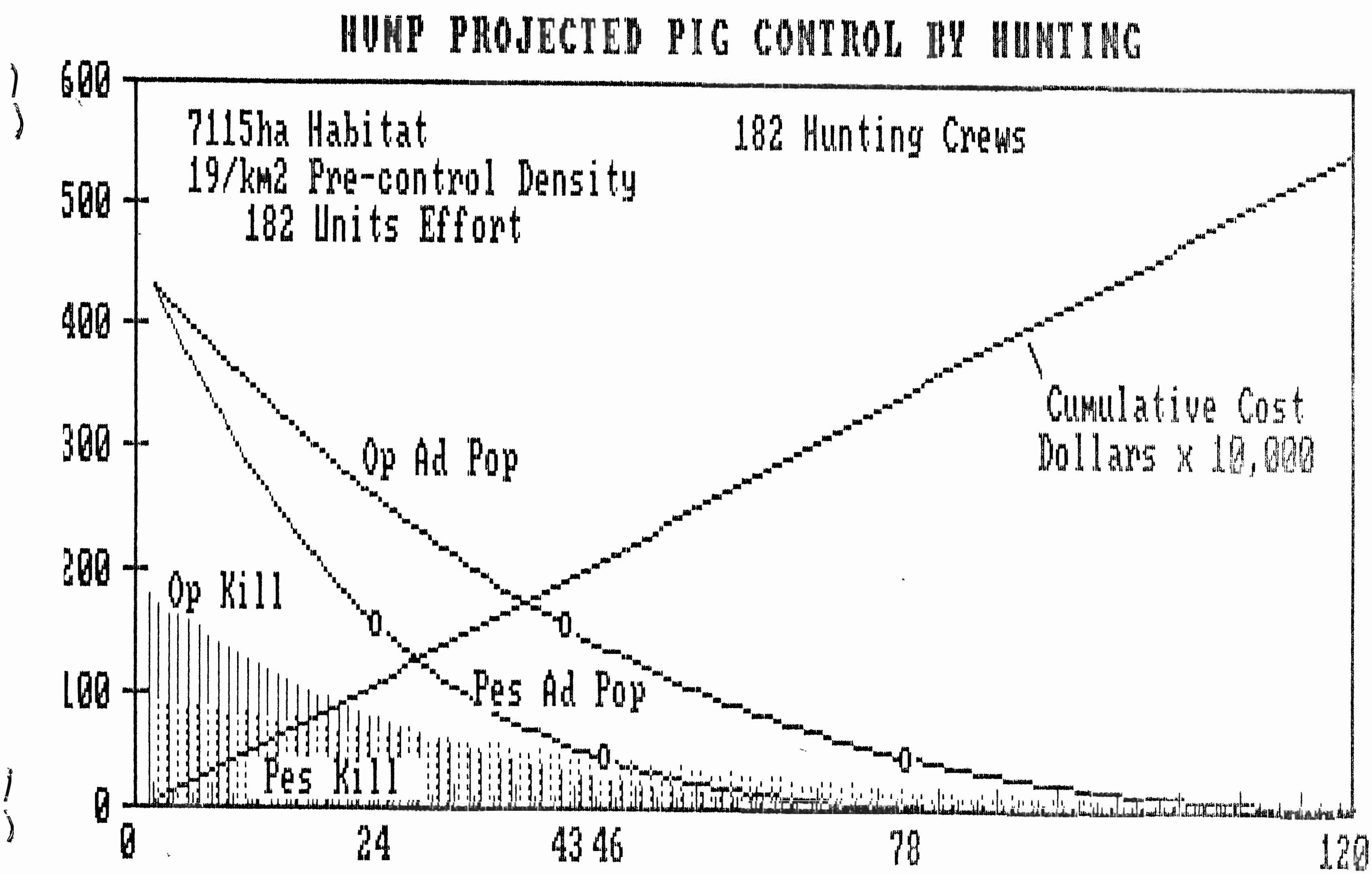
Hawaii Volcanoes National Park



ONE 6-MONTH SEASON = 24 WEEKS = 120 WORKING DAYS
(A unit of effort is a crew of 2 hunters plus dogs on 125ha one day)
(Op = Optimistic hunting efficiency, Pes = Pessimistic hunting efficiency)

TABLE OF CONTENTS

SUMMARY

Park staff have attempted to control wild pigs, primarily by hunting, since 1916. Recorded annual kill increased from under 50 prior to World War II to approximately 300 during the 1960's. In 1972 a program was instituted allowing citizen hunters to assist in the control of goats and pigs as deputy rangers. The primary effort was goat eradication at first, but switched to pig control as the goat population was reduced. It was realized from the outset that eradication of pigs was an unlikely prospect.

The Deputy Ranger Program included a mandatory check-in procedure so that monthly records of hunting effort and pig kill could be compiled for each of eleven pig management units. The units encompass the entire Park and range from 1332 to 23618 hectares. The total annual recorded kill declined from about 250 to under 150 from the early 1970's to the early 1980's. However, only one unit, the area around Kilauea Crater from Thurston Lava Tube to Bird Park, was cleared of pigs within the decade. Fencing and excellent vehicular access were undoubtedly key factors facilitating the effectiveness of hunting in this unit. Most of the remaining pig habitat in the Park, comprising about 25 percent of the total Park area, still supports pigs at or near carrying capacity despite continuous hunting.

A simulation model was used to examine the impact of the recorded kill on the estimated pig populations in each management unit. In only one case, the Kipuka Ki Unit, did the simulation results indicate that the given kill rates had significantly reduced the population. The model, based on the best information available, indicates that a semiannual kill rate of between 30 and 40 percent of the pre-harvest adult population must be maintained to control the population to half its unharvested equilibrium density. Recent kill rates have averaged only about three percent.

The kill-per-unit-effort data from the Deputy Ranger Program allows calculation of a conservative estimate for the total effort required to eliminate pigs from an area. For example, an estimated 5800 man-days over a five-year period would be required to exterminate pigs from the Puhimau Unit. While more efficient hunters could be used than the average deputy ranger, the effort required to exterminate pigs by hunting with dogs would still be far greater than has been applied to date, except in the few highly accessible portions of the Park.

INTRODUCTION

Administrators of Hawaii Volcanoes National Park have recognized the desirability of eradicating or at least controlling the numbers of feral pigs along with other exotic ungulates since the Park's inception (Baker, 1976; Taylor, 1982). Although various control methods have been attempted, the most commonly used by far is shooting while hunting with dogs. Pigs have been shot more or less regularly by rangers and others since 1916, but attempts to record such efforts were sporadic until 1972 when a Deputy Ranger Program was initiated (Figure 1).

The Deputy Ranger Program was designed to legalize the use of relatively inexpensive labor provided by citizen hunters in assisting the small ranger staff to control exotic ungulates, primarily goats and pigs. At first most of the total effort went toward eradicating goats. As goats became scarce hunting effort switched to pigs. It was realized from the outset; however, that total eradication of pigs was an unlikely prospect.

Properly licensed local hunters were deputized as park rangers after passing a hunter safety course. Deputies were required to sign in and out at Park headquarters each day they were on duty. Various restrictions regarding the use of firearms, dogs, vehicles, and hunting locations were established over the years. Deputy rangers were required to provide certain information when signing in, including the sub-unit of the Park they chose to hunt that day, the total number of persons in the hunting party, and upon leaving, the species, number and sex of any animals bagged. They were allowed to keep all animals they killed.

The cost to the Park for the program has included approximately 2 man-days of ranger time for enforcement and 4 man-days of resource manager time for record keeping and field monitoring per month. Under 1 man-day of resource management time has gone toward record keeping but the efforts at field monitoring and direct control of pigs has been more variable. Up to 10 man-days per month were spent in the field between 1975 and 1980 when personnel were shifted from goat control to pig control. Recently under 2 man-days per month have been allocated to field work with pigs, primarily checking fences and monitoring pig damage.

The Deputy Ranger Program began November, 1972; records have been kept continuously since then and summarized monthly and semi-annually. The purpose of this report is to review all the available records through February, 1983. In addition to providing a summary of pig hunting in the Park, an attempt was made to assess its impact on the population. Of particular interest were 1) to what extent hunting might have reduced pig numbers and damage to vegetation below levels expected without hunting, 2) the cost of managing the program, and 3) whether the benefits derived were greater than the costs incurred.

METHODS

Monthly data were available for each pig management unit from November, 1972 to the present except for fiscal years 1977 and 1978. These data were apparently disposed of by mistake; however, Park-wide summaries were available for this period. Since much of the Park was closed to Deputy Ranger hunting after Christmas 1982, most analyses are limited to the periods November, 1972 to June, 1977, and July, 1979 to December, 1982.

In July, 1981, the system of pig management units was modified (Figures 2,3). All data were analysed on the basis of the current scheme. The total land area and the area of pig habitat were determined for each unit by planimeter from maps in Park files. The percentage of each unit within 500m of a road or major trail was also determined by planimeter. This zone was considered readily accessible to deputy rangers based on the results of extensive surveys of the distribution of pig sign relative to roads and trails in hunted and unhunted portions of Hawaii (U.S. Fish and Wildlife Service, unpublished data).

The ecological carrying capacity, or unhunted equilibrium density, for pigs was estimated for each unit on the basis of vegetation maps (Mueller-Dombois and Fosberg, 1974) and estimates of pig density by vegetation type for unhunted populations provided by Giffin (1972:61-77). Giffin's estimates were obtained from line transect censuses carried out in many locations around the island of Hawaii. While both the vegetation type maps and the density estimates are crude, they are the best presently available. We emphasize, our carrying capacity figures are our best estimates for the average number of pigs over six months of age that a pig management unit could support over the long term without human disturbance; they do not represent the number of pigs presently existing in the units, nor the desirable number.

Regression analysis was used to derive predictive functions for the relationship between percent harvest and percent accessibility for the 11 management units and for the relationship between hunting effort and pig density. Natural logarithmic transformations were used as necessary to improve the fit of the linear, least squares functions.

We attempted to correlate the mean monthly pig kill per hunting party (our best index of pig density) with the monthly precipitation records from Park headquarters and from Kalapana weather stations. Rainfall and pig index data were summarized for 3-, 6-, and 12-month periods as well as monthly, and each data set was analysed by correlating pig abundance with rainfall occurring zero to several years previously. We hypothesized that periods of low rainfall might lower pig survival and consequently the success of hunting efforts. There are likely no important sources of pig mortality in the Park other than starvation and hunting (legal and illegal). In very dry periods younger pigs may succumb to dehydration in some habitats, but older pigs are likely to disperse to more mesic habitats in dry periods.

All data were compiled in computer files on diskettes for easy storage and analysis (Appendix A). The data base management software used was VISIFILE for the IBM-PC (Ewing, 1982a). Statistical summaries and graphical presentations were accomplished with VISITREND and VISIPLOT (Ewing, 1982b) which are compatable with VISIFILE via the DIF format (Kalish and Mayer, 1981).

A feral pig population modeling template (Appendix B) was constructed for VISICALC (Wolverton, 1981), based on natality and mortality schedules derived from studies of feral pigs in California and Australia (RHB unpublished data). This model accepts information on estimated carrying capacity, initial population structure and 6-month harvests, thus allowing one to project the pattern of population change over time given a known harvest pattern. We believe that assuming a constant carrying capacity is reasonable for the Park environment. Models were constructed for three pig management units with divergent harvest histories to illustrate the probable impact of hunting on pig numbers. Also, the model is used in a discussion of the general principles of harvesting a feral pig population whether the goal is a maximum sustained yield or animal damage control (Tisdell, 1982:360).

An attempt at a cost-benefit analysis (Mishan, 1976) was made using the best estimates available. All values are in 1983 dollars. An analysis of the relative costs of various alternative control methods was beyond the scope of this report.

RESULTS

The 11 pig management units subdivide the entire Park into areas of 1332 to 4135ha. Unit boundaries are along fences, roads or natural features (Figure 3). The proportion of each unit considered suitable pig habitat varies from 10 to 100 percent, the average for the Park as a whole being 25 percent. These percentages may be overestimates as recurring volcanic activity periodically reduces the amount of pig habitat. A significant portion of Unit 7 was covered by new lava in 1983. Accessibility within the units ranges from 5 to 99 percent and averages 15 percent for the entire Park (Table 1).

Five broad habitat types based on vegetative cover were recognized in the process of estimating the carrying capacity of each unit for adult (6+mo) pigs: 1) sub-alpine (2 pigs/km2), 2) submontane seasonal scrub (5 pigs/km2), 3) ohia-uluhe forest (10 pigs/km2), 4) montane seasonal forest (20 pigs/km2), and 5) ohia-hapu'u forest (40 pigs/km2). The estimated carrying capacities for the units ranged from 30 to 1650 pigs; the Park-wide estimate totaled 4560 pigs. Two thirds of this total is carried by only two units: Ola'a Tract and Kalapana (Table 1).

A summary of the data derived from the Deputy Ranger Program (Appendix C) is provided in Table 2. The important patterns emerging from these data are: 1) numbers of pigs harvested per month were relatively low compared with the estimated carrying capacities of the eleven management units (<1 to 25 percent of unit carrying capacity and 3 percent Park wide); 2) hunting effort in terms of groups (parties) per month and total hunter-days has declined; 3) in some units the pigs killed per group and the percentage of groups successful in killing any pigs (both indices of pig abundance) increased over the period; 4) only one unit (Unit 11 - Kilauea Crater) was successfully cleared of pigs, although a second (Unit 2 - Kipuka Ki) was hunted heavily enough to result in a significant reduction in pig density.

An analysis of the records for the number of boars versus sows harvested found no consistent evidence for hunters selecting one sex over another. Although no accurate records of the ages of pigs harvested were kept, comments on some records and discussions with hunters lead us to believe there has been no strong selection for age, other than that piglets less that six months old were generally not taken by hunters. Some piglets are killed by hunter's dogs but generally not recorded in the harvest records. Thus, it appears that hunting with dogs in the Park is nonselective for sex or age for adult (6+mo) pigs. Most Deputy Rangers are primarily interested in obtaining meat and take every adult pig they can. Occasionally boars are captured alive, castrated and released to be captured again later as barrows. For example, we trapped a yearling barrow in the Puhimau unit that had recently been castrated as the incisions were only partly healed. Barrows tend to grow larger, carry more fat and taste better than boars (Barrett, 1978).

In looking for explanations for the patterns found in the data (Table 2, Appendix C) we first considered the influence of the accessibility of pigs on hunter interest and effort. It is well known by sportsmen and fish and wildlife agencies that as hunters must hike farther from access roads and major trails, interest and effort fall off. Despite the use of dogs when hunting pigs, the survey data gathered by the U.S. Fish and Wildlife Service and our own observations of pig sign indicate that the general pattern also holds for Deputy Rangers in HVNP.

Further support is provided by a regression of the mean monthly kill as a percentage of the estimated carrying capacity for each unit on the percentage of the unit within 500m of a road or major trail (Figure 4). Note that for Units 2 and 11 the percent harvest figures are derived from the modeling efforts described in detail below rather than the unmodified harvest rates. Because of the dynamics of harvested populations (a small number of pigs removed can represent either a very small or a very large percentage of the pre-hunt population) we believe these modified values are more accurate than assuming the pre-hunt population was at the carrying capacity for these units. This issue will be considered further in the discussion. Moreover, units 2 and 11 are critical as the significance of the regression depends in large part on their values. The regression indicates that hunting as exemplified by the Deputy Ranger program in the Park has little impact unless nearly all of a unit is within 500m of a road or major trail.

Data for the effort required to kill a pig (assuming two man-days are equivalent to one group-day) were regressed on the estimated pig density in each management unit for the periods 1972-77 and 1979-82. Data for periods with very low hunter use were omitted, leaving 16 data points for the analysis. We found that the kill per group was not influenced significantly by the number of hunters in the group. Since a hunting party of two was typical, we assumed one group-day was equivalent to two man-days of hunting effort. The resulting regression (using natural logarithmic transformations) was significant, suggesting that hunting success is influenced by the density of pigs (Figure 5).

A series of attempts to correlate an index of pig abundance (mean number of pigs killed per hunter group per given time period) with rainfall up to three years prior to the kill period were all unsuccessful. The best correlation (but not statistically significant) was between pig abundance data for Unit 7, Kalapana, compiled on a 3-month basis and rainfall for the 3-month season three years prior (Figures 6,7). Thus, no support could be obtained from the available data for the hypothesis that reduced precipitation resulted in reduced pig numbers. Apparently weather has only minor effects on the dynamics of pig populations in the Park.

Three units were chosen for more intensive analysis using simulation modeling. Unit 5, Puhimau, was chosen as an example of a lightly harvested unit; it is also the site of ongoing studies of other control methods. Unit 2, Kipuka Ki, is an example of a moderate to heavily harvested unit which presently has a reduced pig population. Unit 11, Kilauea Crater, is the lone example of a unit in which hunting (combined with fencing) has successfully eliminated all pigs. In each example the appropriate carrying capacity and recorded kill figures were entered into the model (Appendix B). Since the initial population structure was unknown in all cases it was assumed that it would be approximated by the stable structure (Caughley, 1977:89) predicted by the model for a population in which adults (6+months of age) were harvested without selection for sex or age at a constant rate equal to the average recorded kill for the early 1970's.

e825

Figure 8 presents the results of the Puhimau simulation in which the starting population structure was that for a 5 percent harvest from an area with a carrying capacity of 220 adults. The stable (pre-Program) population was held at 99.5 percent of carrying capacity by a harvest of 10 adults every six months. Beginning in the second half of 1972 the simulated harvests were the 6-month totals actually recorded; they also had little impact on adult pig density. Note that the area of the graph labeled "PIGLETS" represents the total number of piglets farrowed per six month season and not the number alive at any instant as piglet mortality is very high even under good conditions. Beginning in 1983, four levels of pig removal were simulated: 20, 40, 80, and 120 adults removed per season. The first two levels result in stable populations only slightly lower than at present while the other two alternatives result in extinction approximately 5 and 3 years after commencement, respectively. The implications of these results will be elaborated on later.

Figure 9 presents the results of the Kipuka Ki simulation in which the starting population structure was that for a 1 percent harvest from an area with a carrying capacity of 80 adults. Since there is a pig fence just west of the boundary of Kilauea and Kipuka Ki units, for this analysis we considered the fence as the unit boundary. Hence, Kipuka Ki itself, with an estimated carrying capacity of 10 adult pigs was shifted to the Kilauea Crater Unit, leaving 80 rather than 90 as the carrying capacity for the Kipuka Ki Unit. It does appear that pigs have been eradicated from Kipuka Ki east of the fence, thus we believe it is appropriate to model it with the Kilauea Unit.

The stable (pre-Program) population of the Kipuka Ki Unit was held at 99 percent of carrying capacity by a harvest of 1 adult every six months. A 1 percent harvest was arrived at through multiple simulation runs. The recorded kill was moderately high but quite variable. We knew that the population had not been exterminated and there was minimal immigration as the area was fenced for pigs. The simulation analysis showed that a stable population harvested at 2 percent or greater, and subsequently subjected to the known kill record (1972-82), would go extinct before 1980. Therefore we used a 1 percent harvest figure as the highest that could be supported and still be consistent with the available data. The results in Figure 9 suggest that the adult population in Unit 2 was about 12 percent of carrying capacity or 10 animals in January, 1983. The average harvest rate represented by the recorded kill, as predicted by the simulation in Figure 9 was about 57 percent.

Figure 10 presents the results of the Kilauea Crater simulation in which the starting population structure was that for a 57 percent harvest from an area with a carrying capacity of 130 adults. The stable (pre-Program) population was held at 11 percent of carrying capacity by a harvest of 8 adults every six months. A 57 percent harvest was arrived at through multiple simulation runs. The recorded kill was low relative to carrying capacity (2 percent) but the population was exterminated in 1980 nevertheless. The only way in which the recorded kill could have accomplished this, assuming the remaining parameters in the model are accurate, would have been for the beginning stable population structure to be the result of a stable harvest of at least 57 percent. As for Unit 2, this pre-Program harvest rate was that used in the regression analysis of Figure 4 (rather than the ratio of the average kill to estimated carrying capacity--a much smaller percentage).

The cost (1983 dollars) to the Park of managing the Deputy Ranger Program is estimated to average about $490 per month, primarily for labor (Table 3). Although no additional permanent staff were required, the time spent by present staff to administer the program should be considered, as it could easily be diverted to other pressing problems. The benefits to the Park are much more difficult to evaluate although it is universally agreed that any reduction in damage to native vegetation and fauna in the Park has definite value. Extensive rooting decreases the aesthetic enjoyment of Park visitors in addition to disrupting pristine patterns of community succession and even organic evolution. Any dollar value applied to these benefits would necessarily be arbitrary. Nevertheless, to stimulate discussion, we considered that if the monthly removal of 20 adult pigs results in saving 18 ha from depredation (assuming a pig roots 25m2 per day and recovery requires 12 months), and if a hectare of pristine land nearby could be preserved with a conservation easement for $30 per month, one could argue that a minimum value for this level of pig removal would be $540 per month.

Given the difficulty of deriving an appropriate dollar value for natural ecosystem processes, perhaps all one can say is that significant reduction in pig damage due to the Deputy Ranger Program has been limited to about one percent of the Park, including: 1) elimination of damage to the Kilauea Crater Unit, 2) a substantial reduction of damage in the Kipuka Ki Unit, and 3) some reduction in damage along roads and major trails in the remaining areas. Overall, this leaves some 22,000ha or roughly 25 percent of the entire Park unprotected from pig depredation.

The relationship between pig density and area of understory destroyed by rooting per 6- and 12-month period in the ohia-hapu'u forest habitat is illustrated in Figure 11, which is based on data from Cooray and Muller-Dombois (1981) and our own observations in the Park. Unharvested pig populations in this habitat are presently destroying the understory vegetation on an estimated 18 ha per km2 per 6-month season.

The cost to the Deputy Rangers for an average of 25 trips per month (Appendix C), assuming the average cost of vehicle milage, upkeep of hunting dogs, and ammunition etc. was $25 per trip, is estimated at $625 per month. This cost is far outweighed by the benefits derived if one assumes the value of a day's hunting recreation is $10 and the value of a kilogram of dressed pork is $3 (current market value in Hilo). Given that the records show an average of 60 hunter-days per month and an average kill of 20 pigs (averaging 27kg dressed weight) per month the benefits derived by the hunters total $2220 per month. The ratio of benefits to costs borne by the Deputy Rangers is thus over three to one. Note that this ratio is not the appropriate one for decisions by the Park, which should take into account all social costs and benefits. Unfortunately, we know of no satisfactory way to place a dollar value the loss of Park resources to pig rooting.

DISCUSSION AND CONCLUSIONS

Unfortunately, little can be said about the accuracy of the data base we had to work with. It is probable that all figures are underestimates due to hunters failing to sign in or out. Recently, it is likely that some "hunters" have spent more time tending plantings of marajuana than pig hunting, thus inflating estimates of effort required to bag a pig. We believe we can see shifts in trends in the data at the time of changes in resource managers which could be a result of minor changes in protocols for gathering or summarizing data. In one case (1980) a major inconsistancy in the data is evident. This is the result of a tendency to discard records of unsuccessful groups which was rectified in 1981. Lastly, we note that periodic hunting closures due to eruptions, fires, nene breeding and similar conflicts undoubtedly contribute to variation in hunting effort in some Units. Details of these closures were not recorded.

Despite the fact that there is a two-year gap in the records for the Deputy Ranger Program, and that the accuracy of the available data is questionable, a number of biologically reasonable patterns can be detected. We present these (after ten years of the Program) in the hopes that they will assist the Park in its continuing effort to minimize the impact of feral pigs on the flora and fauna of an International Biosphere Reserve.

Hawaii Volcanoes National Park still has a major pig depredation problem, as approximately 25 percent of the area (22,000ha) supports pigs at or near ecological carrying capacity. Pigs at densities of about 40 per km2 (the carrying capacity for pigs in ohia-hapu'u forest comprising 34 percent of the total habitat) destroy the understory plant cover on about 50 percent of the rootable ground surface annually (Figure 11), in addition to injuring or killing significant numbers of tree ferns (the primary sub-canopy), koa and other native seedlings, and encouraging exotic plants such as strawberry guava and banana poka (Cooray and Muller-Dombois, 1981; Diong, 1983). The positive response of understory vegetation to the exclusion of pigs in several sites around the Park clearly demonstrates that pigs are at least maintaining some communities in disclimaxes substantially different from that expected in a pristine environment (Spatz and Muller-Dombois, 1975; Higashino and Stone, 1982; Stone, unpub. data). Only two percent of the habitat suitable for pigs has been fully protected. Even this area, the Kilauea Crater Unit encompassing the Park headquarters, is preserved only by regular maintanance of pig-proof fencing.

It might surprise some that the elimination of over 230 pigs a year for nearly a decade has not had a greater impact on the problem. There are two reasons why hunting has not had more impact. First, the tendency for hunters whose motivation is primarily recreation rather than eradication is to select areas within easy walking distance of vehicular access points and with relatively high densities of pigs. Therefore, portions of the Park more than a kilometer from roads and major trails are essentially unhunted (Figure 12, based on Figure 4), and as soon as hunting reduces the population of an accessible area very much, hunters lose interest and move their effort to another, more promising area (Figure 13, based on Figure 5). This tendency was evident in the monthly kill records. There were several instances in which the good success of a group hunting a unit which had been unhunted for a time was followed by a distinct shift in effort to that unit from other areas with lower success rates. This behavior coupled with a relatively static pool of local hunters interested in the Deputy Ranger Program results in a relatively constant, evenly dispersed, but inadequate control effort over the accessible portions of the Park.

The second reason why the Program has not had more impact is a function of the dynamics of harvested feral pig populations. Pigs are the most prolific ungulate on earth, having an intrinsic rate of population increase more like a rodent than an ungulate (Barrett, 1978; Pond and Houpt, 1978). A sow first produces a litter of four to eight young at about a year of age and continues to farrow increasingly large litters approximately every six months for the rest of her life (four to seven years in an unharvested population). Moreover, in the Hawaiian environment, especially in ohia-hapu'u rainforest, the only significant mortality factor other than hunting is malnutrition (Giffin, 1972; Baker, 1976; Diong, 1982).

To provide a concrete illustration of the practical significance of the pig's high reproductive potential we have modeled the growth of a hypothetical pig population stemming from the introduction of a one-year-old, pregnant sow into the 4135ha Ola'a Tract assuming it had been fenced and cleared of pigs (Figure 14). The population grows to less than 300 animals in the first four years; however, in the next four years it reaches and even overshoots the estimated carrying capacity of 1650. Thus, an illegal introduction might go undetected for several years and "explode" only a few years later. One way to describe the growth of a newly established feral pig population in good habitat is to note that it can double every four months if not hunted.

The same model (Appendix B) used for the above illustration can be used to illustrate the response of the pig population in the Puhimau Unit to various intensities of hunting. Typically, such models are represented graphically in the form of "yield curves", representing the absolute number (Figure 15), or the relative number of individuals (Figure 16), that can be harvested periodically (every 6-month season in this case) without changing the "standing crop" at the beginning (or the end) of the next period. Thus, for example, a "sustained yield" of 12 adult (6+mo) pigs could be harvested from a standing crop of 221 adults leaving a post-hunt population of 209 (a 5 percent harvest rate). Alternatively, a sustained yield of 12 adults could be harvested from a standing crop of 21 leaving a post-hunt population of 9 (a 57.5 percent harvest rate). In both cases the post-hunt populations would grow to the pre-hunt standing crop again by the next 6-month season. Of course the figures presented here should not be taken too literally as they are based on rather crude estimates of carrying capacity, plus various assumptions about natality, natural mortality and lack of selection for certain age classes by hunters. Nevertheless, they are the best estimates available and we believe they are reasonably accurate.

In the present context Figure 17 may be a more useful view of the same information. It indicates the number of adult pigs that must be harvested to maintain a given post-harvest density in the Puhimau Unit. For example, to maintain a post-harvest density of nine adults per square kilometer (half the density at carrying capacity) would require a regular harvest of 55 pigs (34 percent of the pre-harvest adults) every six months. Notice that the maximum sustained yield (MSY) for this population is predicted to be 57 (36 percent of the pre-harvest adults) every six months. MSY is often a management goal for those interested in the production of meat or related resources.

Censusing wildlife is generally a difficult task. Traditionally, wildlife managers have attempted to interpret population trends from age composition data obtained from harvested animals or sample counts. Such attempts are fraught with pitfalls (Caughley, 1976:120-123); however, the stable age distributions presented in Figure 18 may be of use in interpreting age composition data for pigs in HVNP if one assumes a relatively stable carrying capacity, a stable harvest rate and no selection for sex or age classes in the harvest. The most obvious pattern in Figure 18 is that as the percent harvest increases, the maximum and average ages of the pigs decline substantially. Since recent harvests in the Puhimau unit have included pigs up to five years of age it is unlikely that the average harvest rate has been over 25 percent per six-month season. Notice also that with increasing harvest rate the number of piglets farrowed declines, but the percentage of those born that survive to be recruited to the adult population increases dramatically. The model takes into account the fact that hunting losses of adults are compensated for to a degree by improved survival of young. This is based on the assumption that the main factor limiting the population is food availablitiy and that a relaxation of intraspecific competition allows improved survivorship of those individuals remaining, especially piglets.

We noted that a harvest of 12 pigs could be sustained from the Puhimau unit whether the standing crop was 219 or 21 adults.

Obviously, the Park would prefer a standing crop of only 21 as this density would have a minimal impact on the flora and fauna of the area. Unfortunately it is considerably more difficult to harvest 12 pigs from the small population than from the large one. If we assume that the harvest method is hunting by crews of two men and two dogs for eight-hour days we can predict the amount of effort required to harvest 12 pigs in each circumstance based on the regression of Figures 5 and 13. A harvest of 12 pigs from a population of 219 would require an estimated 50 man-days (e.g. one crew for five weeks; five working days per week). The same harvest from a population of only 21 would require an estimated 170 man-days, or over three times the effort for the other situation. The hunting effort predicted for any harvest rate in the Puhimau unit can be seen in Figure 19. Of course, since the predictions are based on the skill and success of the average Deputy Ranger over the past decade, any improvement in the skill or effectiveness of future hunting crews would reduce the effort required accordingly. Effort required to kill a pig at Great Smoky Mountains National Park and at Dye Creek Preserve is less than expected for Hawaii Volcanoes National Park (Figure 19).

There is an additional point regarding the case of a high harvest rate from a low standing crop. Since the present population is near carrying capacity (Figure 8), additional effort must be expended to reduce the standing crop to 21 head before the sustained yield situation can be instituted. This could be done in two ways: 1) remove a given percentage (at least 57.5 percent) of the adult standing crop each season until the population reached 21, or 2) remove a given absolute number (at least 58) each season. The first alternative would require a greater total effort because it would take longer (decades) to drive the population down. The second alternative is illustrated in Figure 20. Here 80 pigs are harvested per season (an increasing percent harvest). Notice that the effort required to take the same number of pigs increases geometrically as the population is driven lower. Figure 20 predicts that it would take roughly 1100 man-days within a six-month period to remove the last 80 pigs from the Puhimau unit if hunting with dogs was the method used. This is equivalent to five crews working for nearly the entire six-month period (assuming five-day work weeks). A total of 5800 man-days of hunting would eliminate the Puhimau pig population in five years. The optimum harvest strategy will depend in part on the logistics of supplying manpower, dogs and equipment for a given unit. We stress, however, that the cost of control will vary greatly, depending on the standing crop, even if a single control method is used. Normally, costs will accelerate over time until extermination is accomplished.

We have considered only one pig control method here. Our analysis of the Deputy Ranger Program found that it was successful in cases where the management unit was a self-contained area of less than 500ha of accessible pig habitat. Pig-proof fencing in conjunction with natural barriers is necessary to eliminate pig dispersal, and most of the area must lie within 500m of a road or major trail. Overall, while the program has not been detrimental, it has not solved the pig depredation problem, nor is it likely to in the future. This does not mean that some form of hunting may not be a useful control method, alone or in conjunction with other methods. For example, systematic hunting by paid professionals, or highly organized hunts by many groups of Deputy Rangers working in concert within a prescribed unit could be tested for their feasibility and efficiency. If pilot studies proved favorable the scheme could be expanded and even combined with other methods. The optimum solution to the overall problem is likely to require an integrated control strategy involving a variety of methods over space and time. Under the special circumstances outlined above, the Deputy Ranger Program may have a place. Otherwise it only provides another, rather unconventional, recreational use of a National Park.

Finally, we must comment on one additional aspect of the Deputy Ranger Program. Sport hunters tend to be bound by tradition. Having put an investment of time and energy into learning the details of a given hunting ground, they resist moving elsewhere unless their success rate declines below some threshold. That threshold for pig hunters in the Hilo area of Hawaii is high relative to hunters in Los Angeles, but since hunter success in Hawaii Volcanoes National Park remains high by most standards, even after decades of hunting, the existing body of Deputy Rangers has a strong interest in preserving their opportunity. A few individuals may go so far as to release domestic pigs or piglets caught by dogs. Releasing castrated boars for later harvest as barrows is less important, but from the Park's point of view, it would be preferable to remove the animal immediately.

The key to success with any control program in which local extermination is a goal is to make it very clear to public participants that their expectations as well as their rights must be limited. While they may be vocal and carry considerable political weight locally, they should realize that they must eventually abide by the wishes of the public at large, which has clearly stated its interest in the preservation of natural ecosystems of, and opposition to public hunting in National Parks. This national interest is expressed in the form of federal legislation and agency regulations which have priority over state and local interests on Federal lands (Wood and Barrett, 1979; Singer, 1981). We recognise that on other lands pig hunting may be a legitimate and even major land use with a managment goal of maximum sustained yield.

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_TABLE 1. Estimated areas and feral pig carrying capacities for management units of Hawaii Volcanoes National Park. Land within 500 meters of roads and major trails is considered accessible.

UNIT NAME		TOTAL (PERCENT)	NON-HABITAT	HABITAT TOTAL	PERCENT ACCESS.	SUB-ALPINE	SUBMONTANE SEASONAL	OHIA-ULUHE	MONTANE SEASONAL	OHIA-HAPU
1. MAUNA LOA	ha	23618 (26)	20757	2861	30	861	0	0	2000	0
	CC	420*(9)	0	417		17	0	0	400	0
2. KIPUKA KI	ha	1332 (1)	892	440	90	0	0	0	440	0
	CC	90 (2)	0	88		0	0	0	88	0
3. OLAA TRACT	ha	4135 (5)	0	4135	5	0	0	0	0	4135
	CC	1650 (36)	0	1654		0	0	0	0	1654
4. KOOKOLAU	ha	6180 (7)	5580	600	65	0	600	0	0	0
	CC	30 (1)	0	30		0	30	0	0	0
5. PUHIMAU	ha	1458 (2)	203	1255	40	0	0	955	0	300
	CC	220 (5)	0	216		0	0	96	0	120
6. PUU HULUHULU	ha	2267 (3)	1117	1150	10	0	0	650	0	500
	CC	270 (6)	0	265		0	0	65	0	200
7. KALAPANA	ha	21088 (23)	13610	7478	5	0	2644	2004	0	2830
	CC	1470 (32)	0	1466		0	132	200	0	1134
8. AINAHOU	ha	4615 (5)	2860	1755	65	0	1000	755	0	0
	CC	130 (3)	0	126		0	50	76	0	0
9. HILINA PALI	ha	3825 (4)	3125	700	45	0	500	200	0	0
	CC	50 (1)	0	45		0	25	20	0	0
10. KAU	ha	19485 (21)	17280	2205	20	0	2205	0	0	0
	CC	110 (2)	0	110		0	110	0	0	0
11. KILAUEA	ha	3090 (3)	2602	488	99	0	0	50	288	150
	CC	120 (3)	0	120		0	0	5	55	60
TOTAL PARK	ha	91093 (100)	68026	23067	15	861	6949	4614	2728	7915
	CC	4560 (100)	0	4537		17	347	462	543	3168
MEAN PIGS / km2		5	0	20		2	5	10	20	40

* Carrying capacity estimate rounded to nearest 10 pigs (over six months of age).

Table 2. Summary data (mean and standard deviation) for the Deputy Ranger Program, Hawaii Volcanoes National Park.

Pig Mgmt. Unit		1	2	3
Hunter Groups	72-77*	8.0(2.36)	10.3(4.44)	-
	79-82**	1.8(3.75)	4.0(3.63)	1.5(2.07)
Recorded Kill	72-77	2.1(2.65)	4.9(5.77)	-
	79-82	0.5(1.03)	2.2(2.62)	0.9(1.82)
Kill/Group	72-77	0.3(0.40)	0.4(0.40)	-
	79-82	0.2(0.42)	0.5(0.52)	0.3(0.49)
Success (%)	72-77	14(14.8)	24(17.5)	-
	79-82	12(72.2)	31(32.4)	19(32.7)
Hunter-days	72-77	21.4(8.78)	22.9(11.3)	-
	79-82	3.7(7.67)	7.8(7.82)	3.0(4.47)

Pig Mgmt. Unit		4	5	6
Hunter Groups	72-77	1.8(1.61)	4.4(2.03)	1.8(1.47)
	79-82	0.5(0.67)	3.2(2.83)	0.4(0.78)
Recorded Kill	72-77	0.8(1.81)	2.3(2.38)	0.9(1.52)
	79-82	0.1(0.37)	1.5(1.67)	0.1(0.21)
Kill/Group	72-77	0.3(0.52)	0.5(0.64)	0.40(0.69)
	79-82	0.1(0.19)	0.4(0.45)	0.04(0.17)
Success (%)	72-77	20(32.8)	36(30.6)	22(32.8)
	79-82	4(17.5)	34(33.4)	4(16.9)
Hunter-days	72-77	3.5(4.01)	8.1(4.44)	3.3(3.06)
	79-82	0.8(1.55)	6.7(5.99)	0.6(1.34)

* n = 56 ** n = 42

Table 2. (Continued)

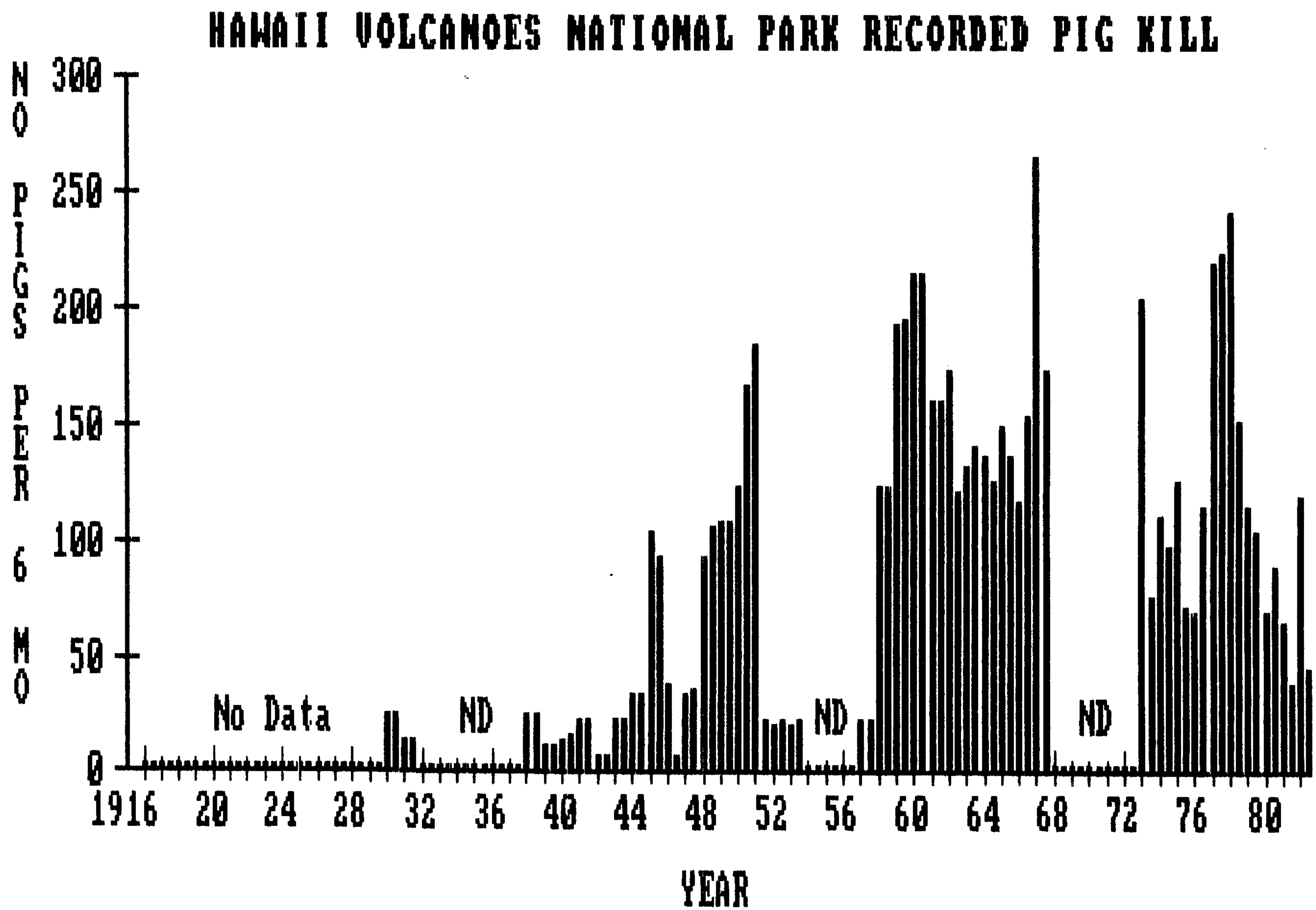
Pig Mgmt. Unit		7	8	9
Hunter Groups	72-77*	5.4(2.26)	1.4(1.26)	1.7(1.34)
	79-82**	4.4(3.33)	1.2(1.93)	0.4(0.82)
Recorded Kill	72-77	9.8(9.17)	0.2(0.47)	0.04(0.18)
	79-82	5.7(5.85)	1.1(3.32)	0.02(0.15)
Kill/Group	72-77	1.7(1.19)	0.1(0.22)	0.01(0.07)
	79-82	1.0(0.99)	0.4(0.90)	0.02(0.15)
Success (%)	72-77	61(26.9)	7(18.9)	1(7.30)
	79-82	45(38.2)	22(37.7)	2(15.2)
Hunter-days	72-77	12.6(8.45)	3.0(3.94)	3.8(3.92)
	79-82	10.2(9.55)	2.4(4.01)	0.7(1.62)

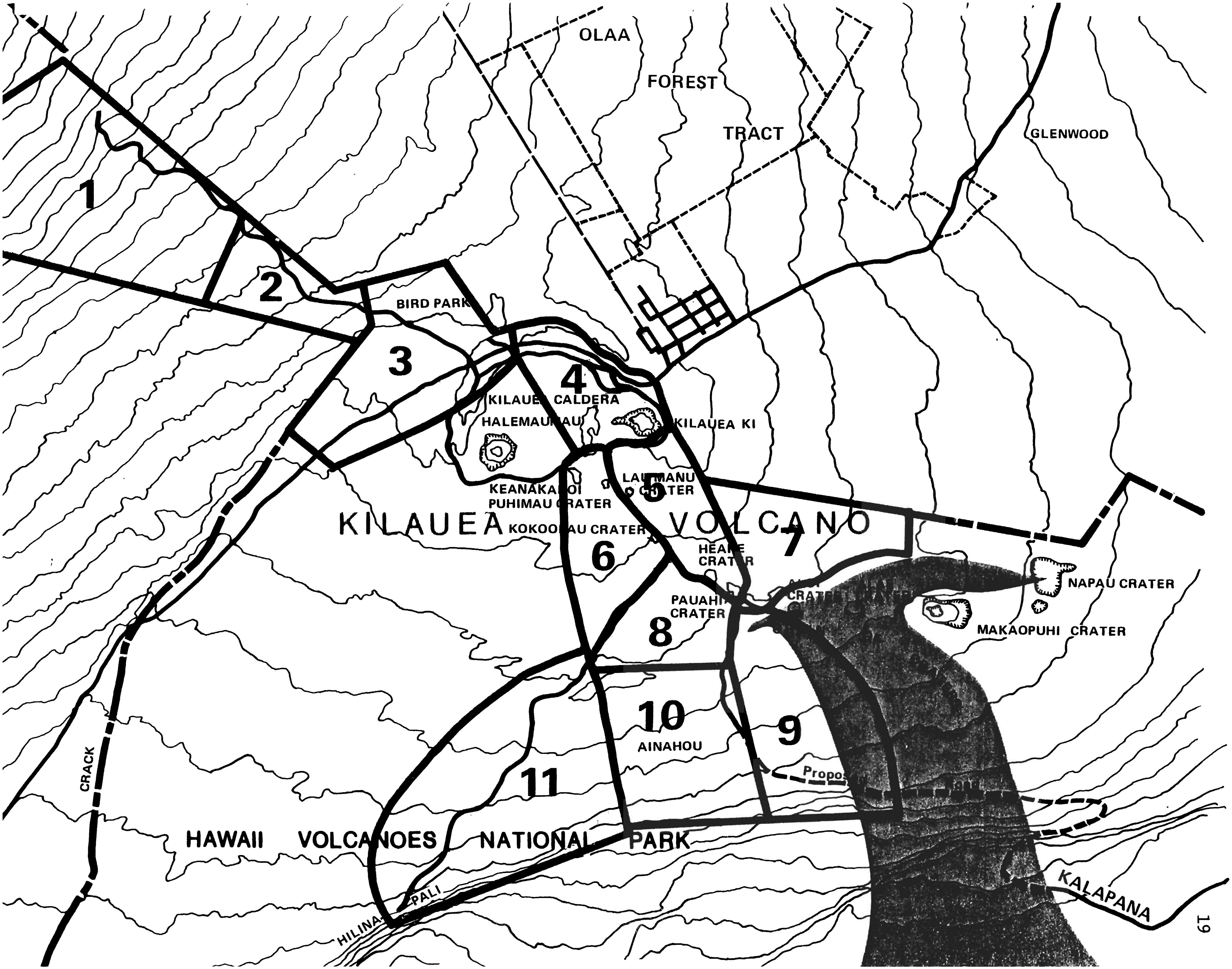
Pig Mgmt. Unit		10***	11	Park Total(3mo)¦
Hunter Groups	72-77	-	2.6(1.75)	110(19.2)
	79-82	0.3(0.57)	1.0(0.82)	55(30.3)
Recorded Kill	72-77	-	0.5(0.89)	60(27.7)
	79-82	0.0(0.00)	0.2(0.37)	38(18.0)
Kill/Group	72-77	-	0.2(0.29)	0.6(0.26)
	79-82	0.0(0.00)	0.1(0.30)	0.7(0.32)
Success (%)	72-77	-	14(21.7)	31(9.03)
	79-82	0.0(0.00)	13(29.8)	21(9.25)
Hunter-days	72-77	-	4.3(3.93)	241(52.4)
	79-82	0.5(0.94)	1.3(1.25)	113(56.7)

* n = 56   ** n = 42   *** n = 19   ¦ n = 18 & 14

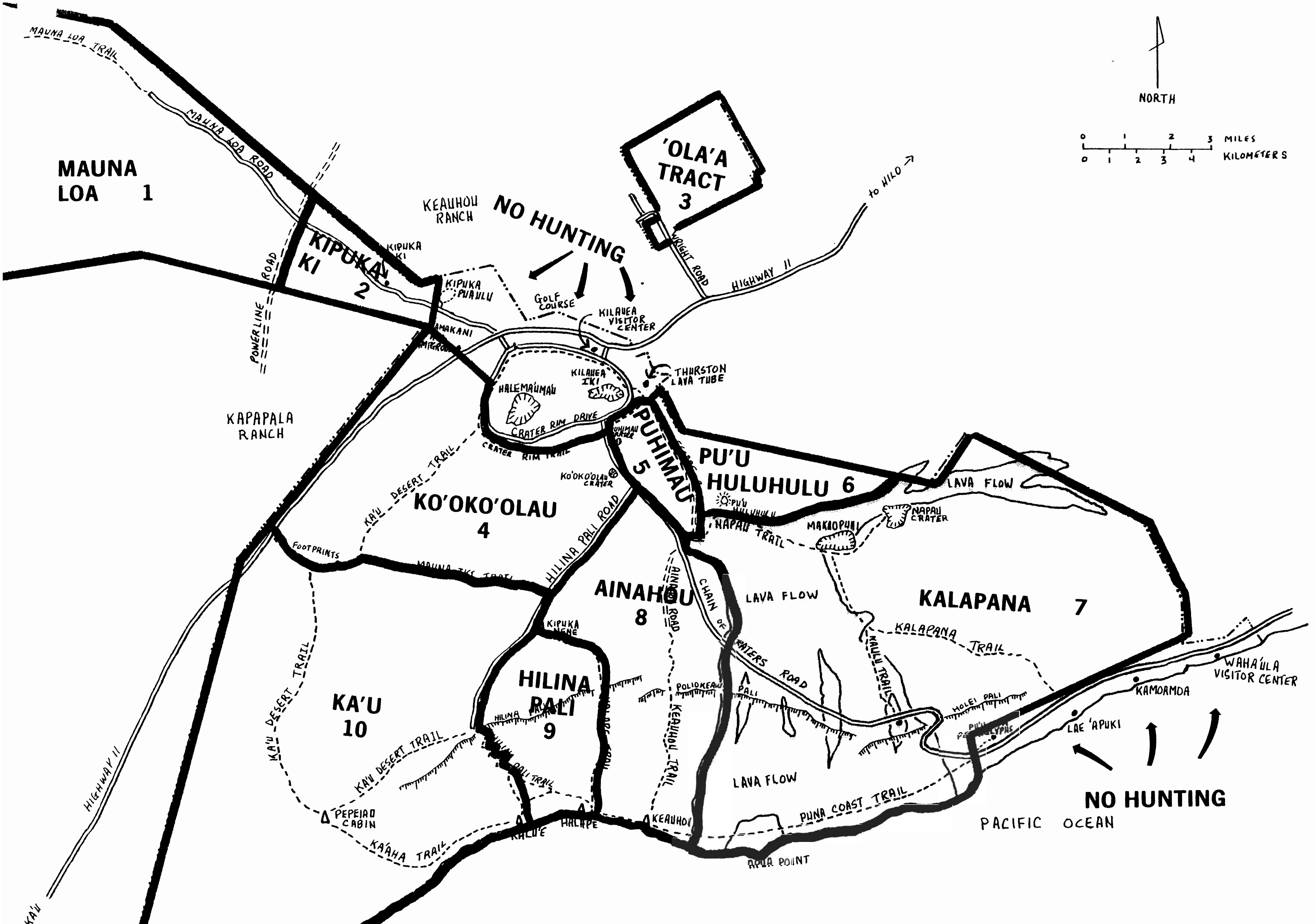
Table 3. Estimated average monthly costs and benefits of the pig hunting program, 1972-1982, Hawaii Volcanoes National Park.

Item	Amount per Month	Unit Value	Total Value
COSTS			
Ranger enforcement (licensing, patrolling, public contact, court)	2 man-days	$85	$170
Resource management (monitoring, data summarization, additional hunting)	4 man-days	$80	$320
Deputy ranger expense (milage, dog care, weapons, ammunition)	25 trips	$25	$625
	Total Cost per Month		$1115
BENEFITS			
Hunting recreation (estimated average "willingness to pay")	60 hunter-days	$10	$600
Meat (20 pigs x 40 kg/pig x 67 % dressed carcass)	540 kg	$3	$1620
Reduction of damage (vegetation, erosion, native fauna, aesthetics; all losses due to rooting of about 25 m2 per pig per day by 20 pigs in 30 days, and damage lasts for 12 mo; conservation easement cost for ha of similar alternative land for 12 mo)	18 ha	$30	$540
	Total Benefit per Month		$2760
BENEFIT/COST RATIOS			
Benefit/Cost Ratio for Hunters = 3.5			
Benefit/Cost Ratio for Park = 1.1			
	Overall Benefit/Cost Ratio		2.5

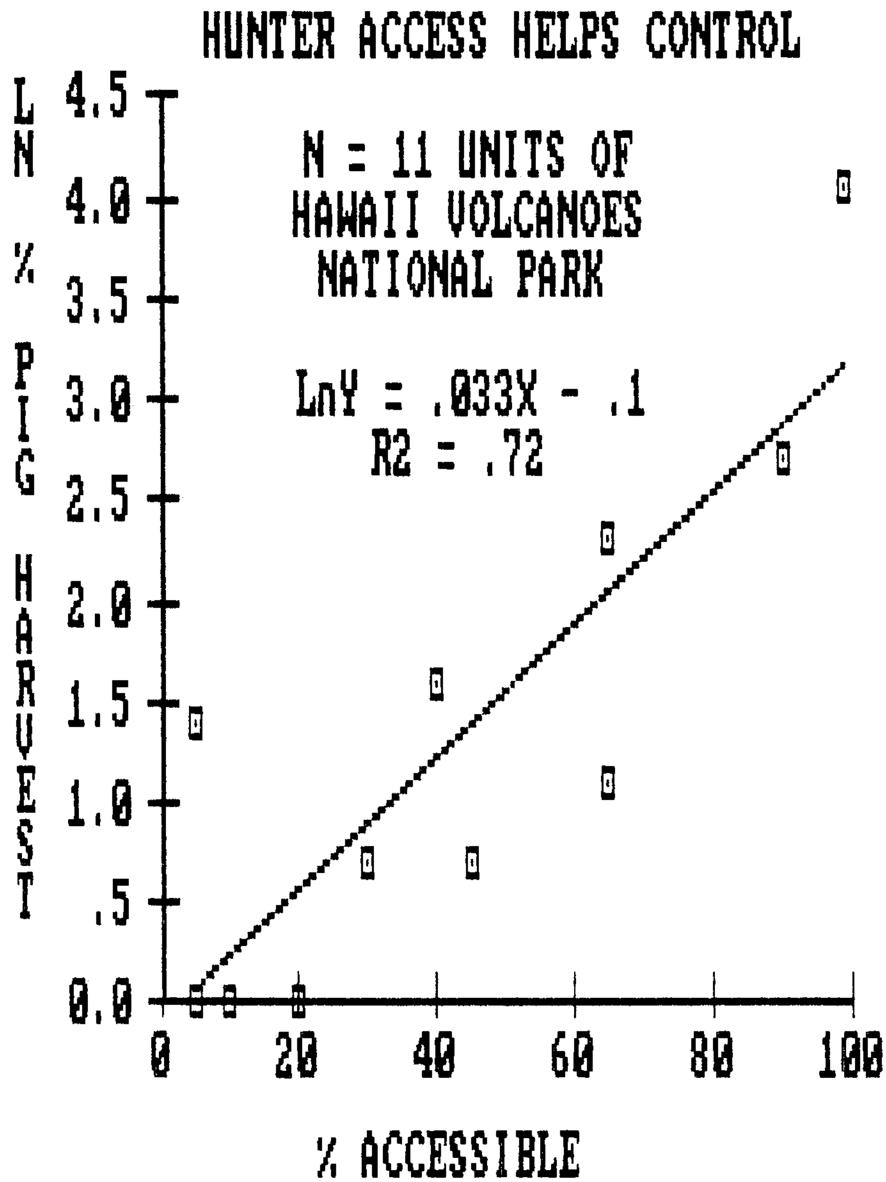

HAWAII VOLCANOES NATIONAL PARK RECORDED PIG KILL
NO PIGS PER 6 MO
300
250
200
150
100
50
0
No Data
ND
ND
ND
1916
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
YEAR

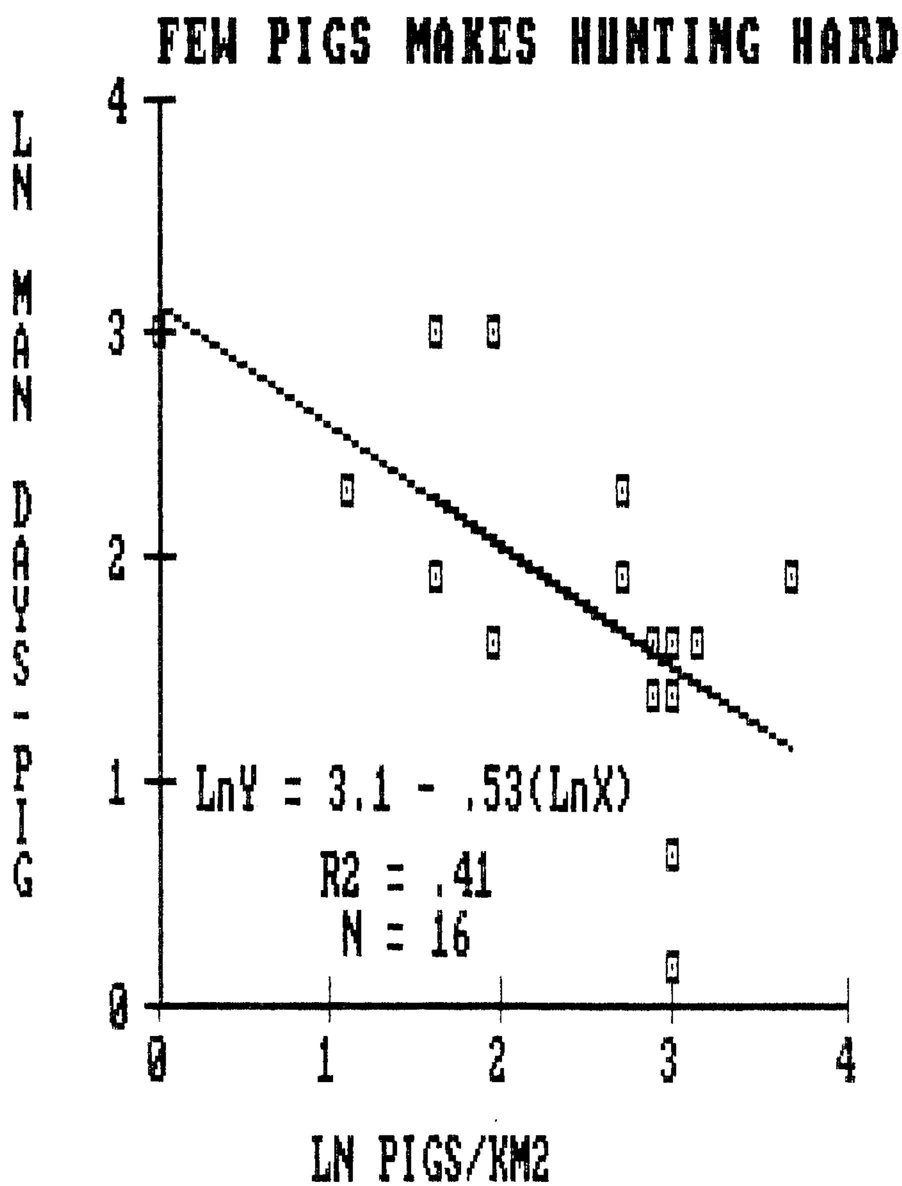


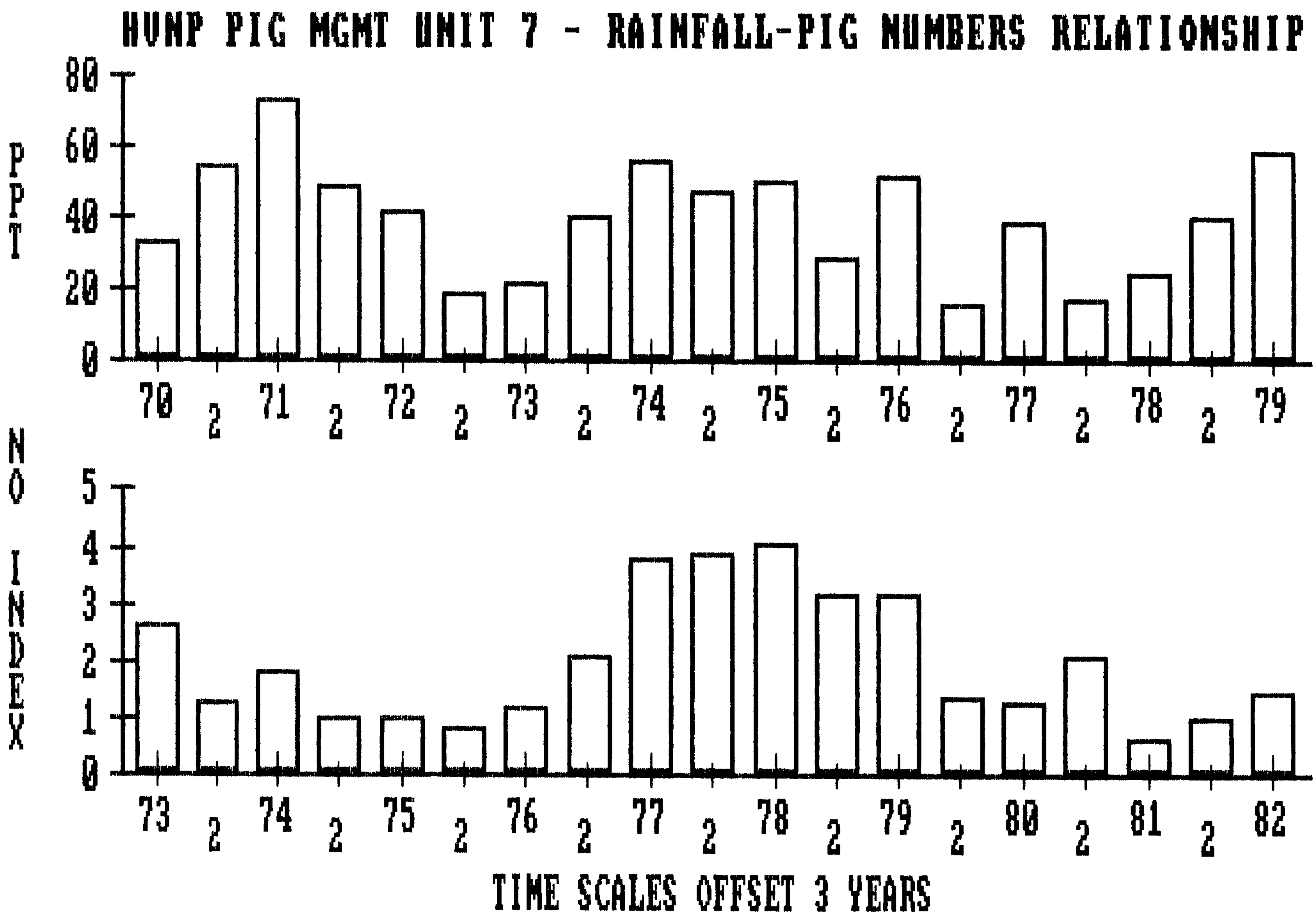
OLAA
FOREST
TRACT
GLENWOOD
1
2
3
4
5
6
7
8
9
10
11
BIRD PARK
KILAUEA KI
PUHIMAU CRATER
KILAUEA
VOLCANO
PAUAHI CRATER
NAPAU CRATER
MAKAOPUHI CRATER
AINAHOU
CRACK
HAWAII VOLCANOES NATIONAL PARK
PALI
KALAPANA



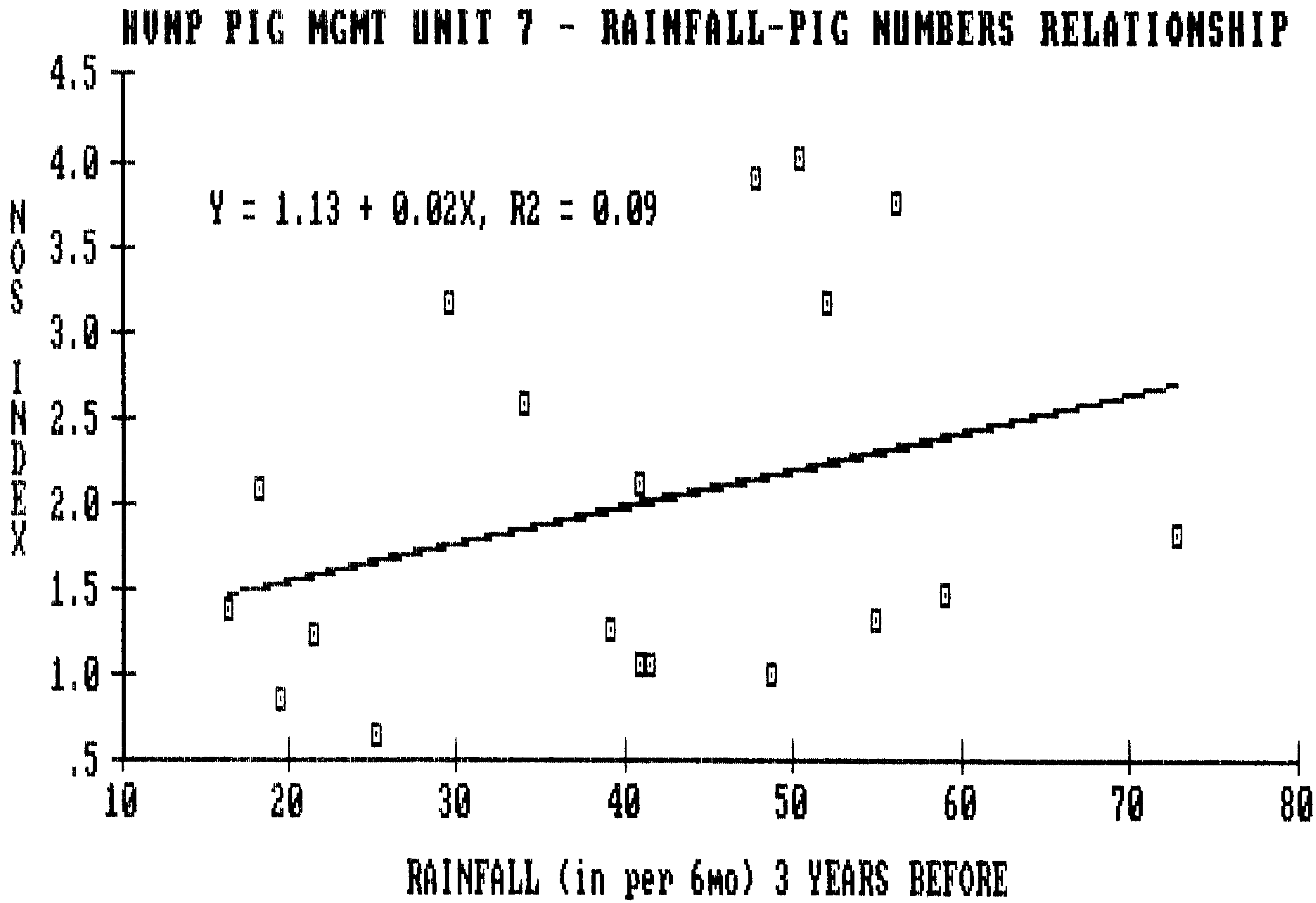
FERAL ANIMAL CONTROL UNIT BOUNDARIES
HAWAII VOLCANOES NATIONAL PARK

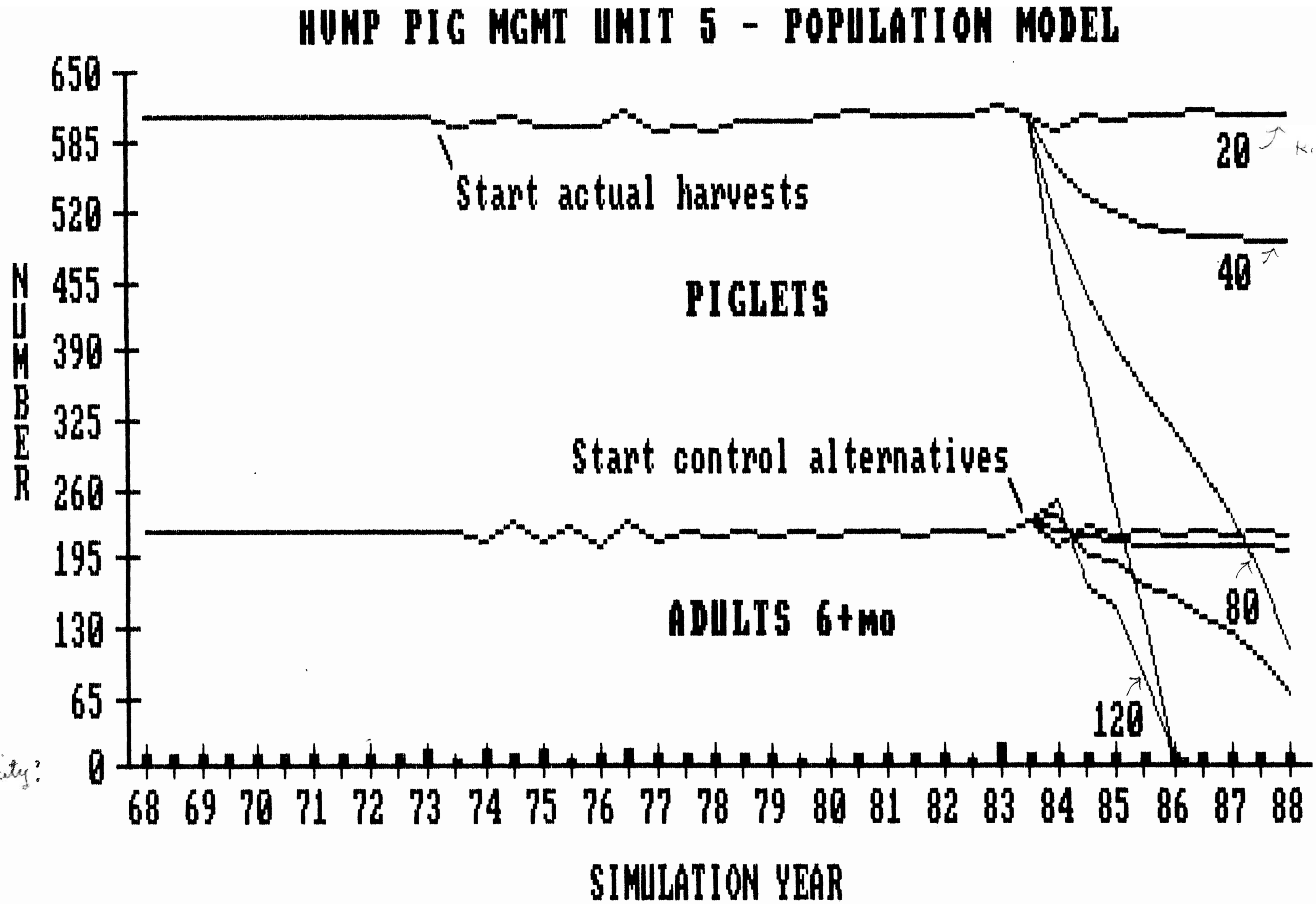

HUNTER ACCESS HELPS CONTROL
N = 11 UNITS OF
HAWAII VOLCANOES
NATIONAL PARK
LnY = .033X - .1
R2 = .72
LN % PIG HARVEST
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
0.0
0
20
40
60
80
100
% ACCESSIBLE


FEW PIGS MAKES HUNTING HARD
LN MAN DAYS-PIG
LnY = 3.1 - .53(LnX)
R2 = .41
N = 16
LN PIGS/KM2
0
1
2
3
4



HUNP PIG MGMT UNIT 7 - RAINFALL-PIG NUMBERS RELATIONSHIP
PPT
80
60
40
20
0
70 2 71 2 72 2 73 2 74 2 75 2 76 2 77 2 78 2 79
NO INDEX
5
4
3
2
1
0
73 2 74 2 75 2 76 2 77 2 78 2 79 2 80 2 81 2 82
TIME SCALES OFFSET 3 YEARS


HUMP PIG MGMT UNIT 7 - RAINFALL-PIG NUMBERS RELATIONSHIP
Y = 1.13 + 0.02X, R2 = 0.09
NOS INDEX
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
10
20
30
40
50
60
70
80
RAINFALL (in per 6mo) 3 YEARS BEFORE



(Assumes adult CC = 220 and nonselective adult harvest)

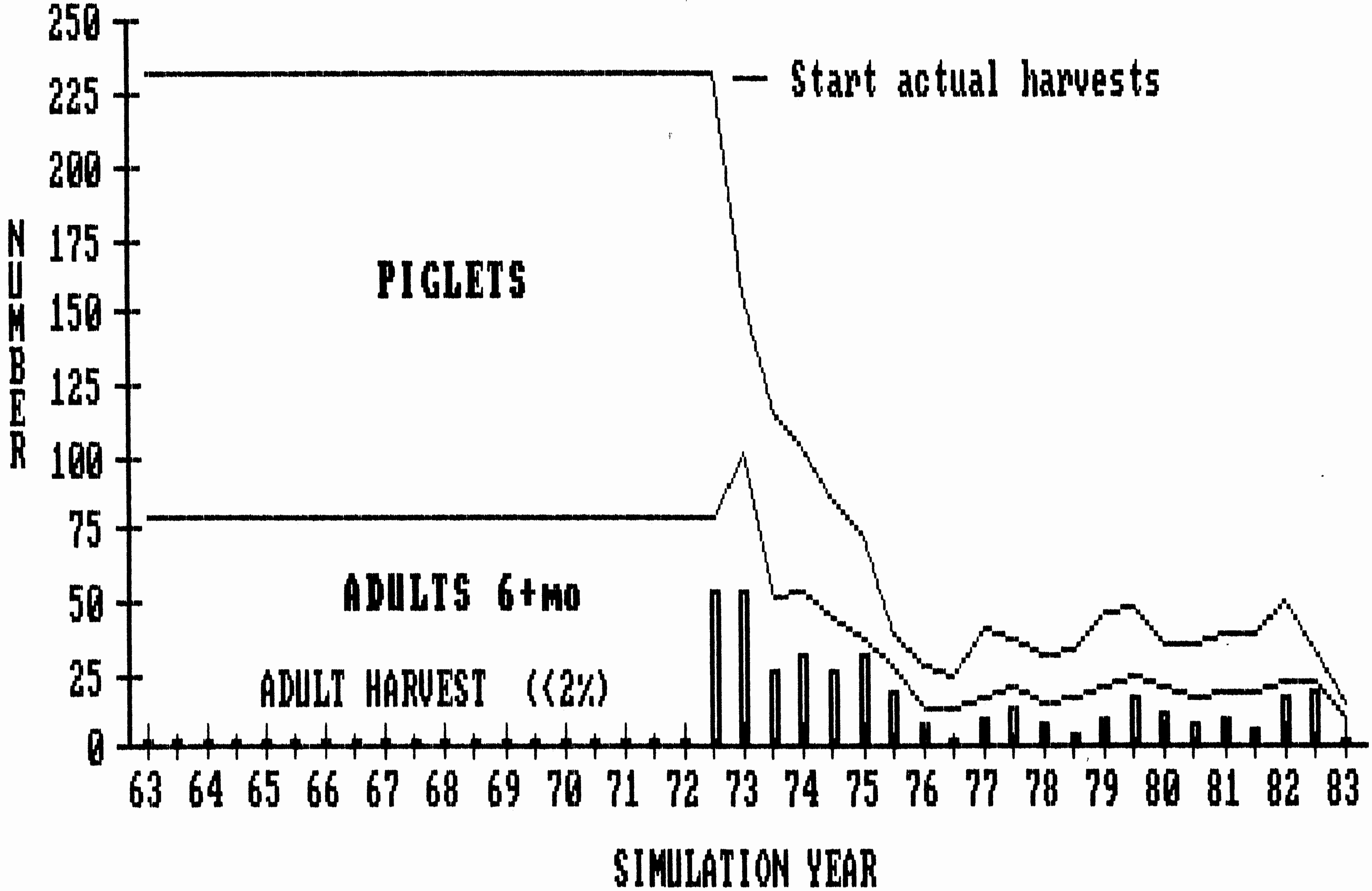
(Numbers to right are adult pigs "controlled" per 6-mo period)

CC mean carrying capacity?

see page 6

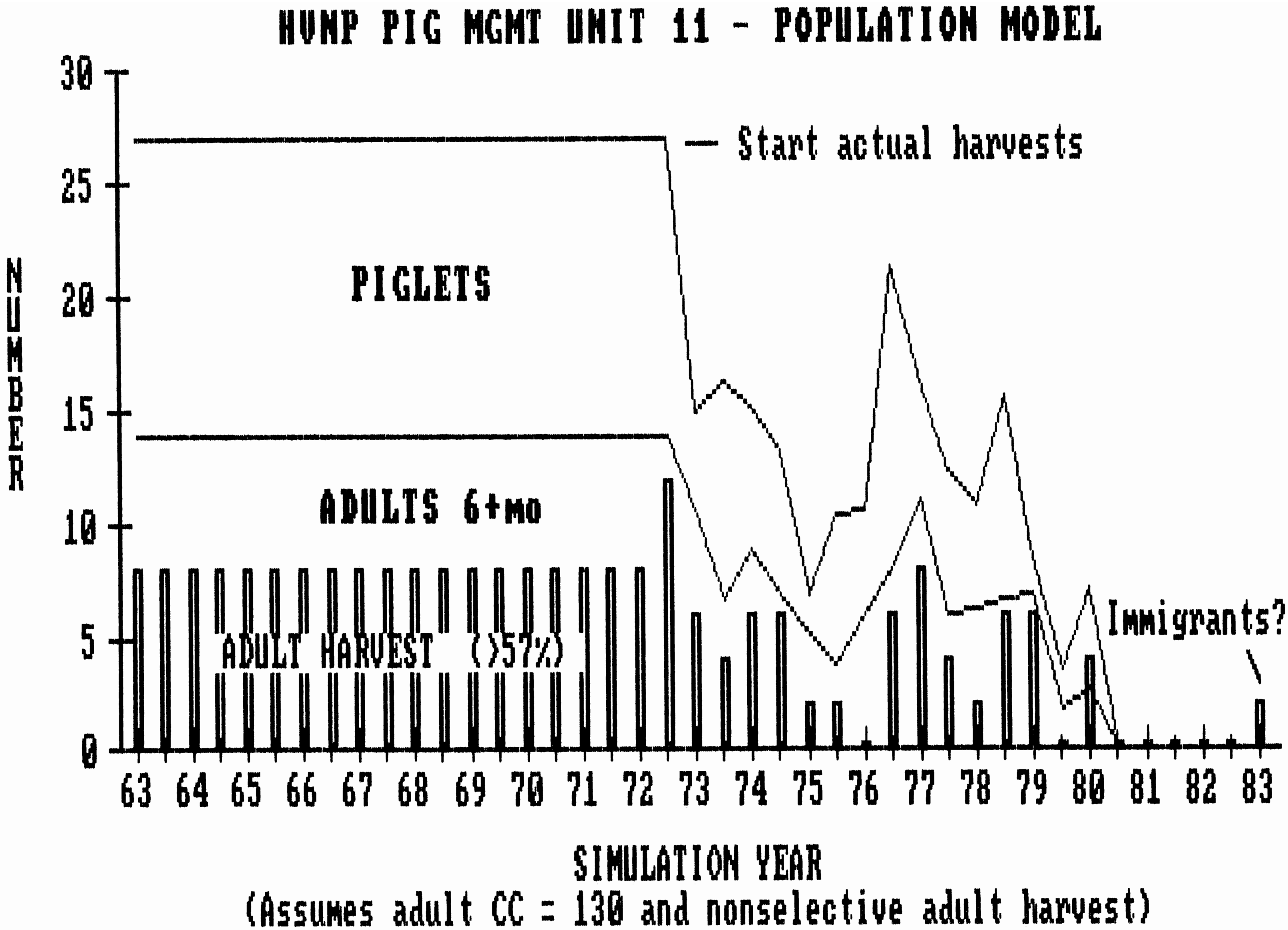
Figure 8

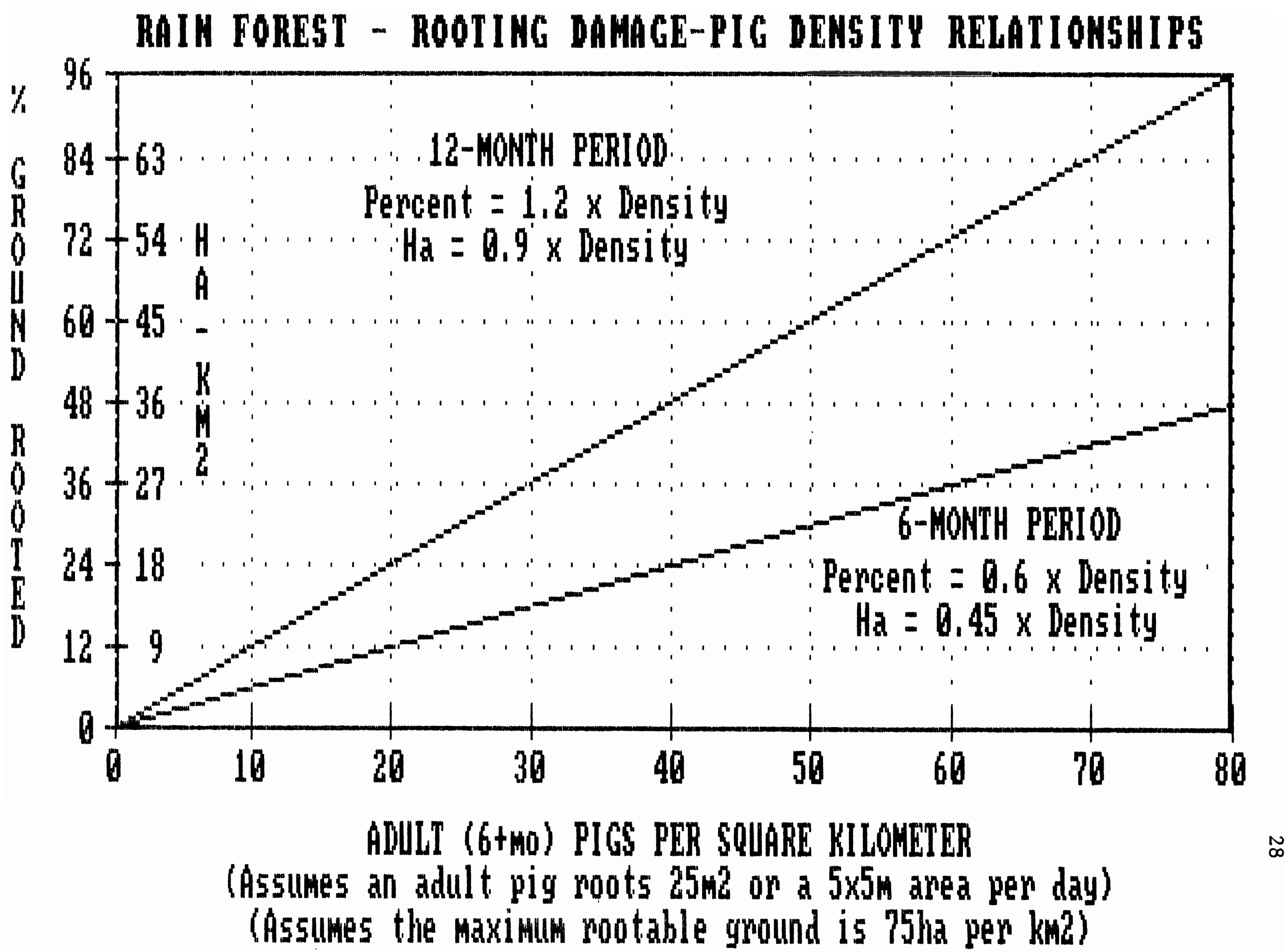
HUMP PIG MGMT UNIT 2 - POPULATION MODEL



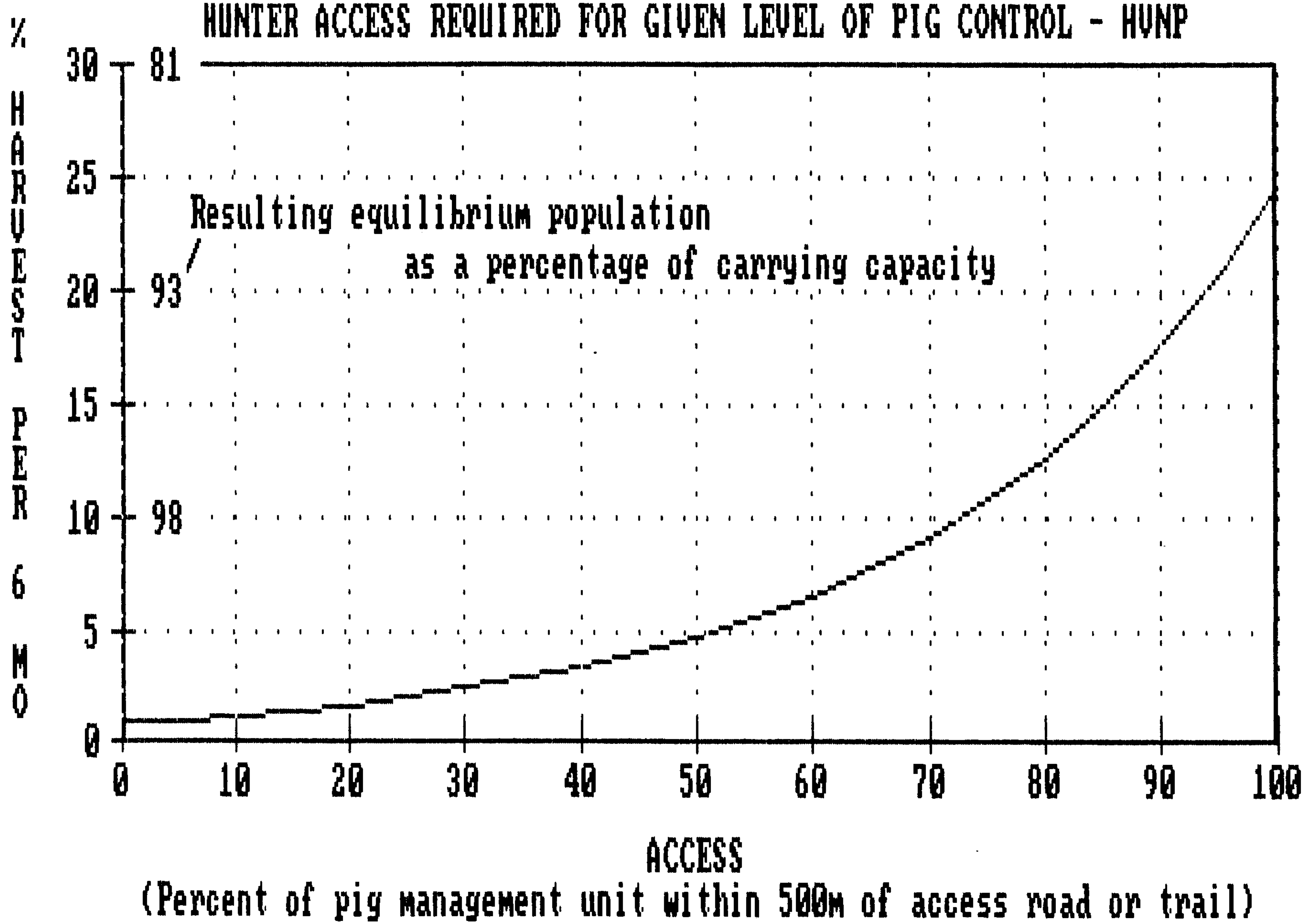
(Assumes adult CC = 80 and nonselective adult harvest)

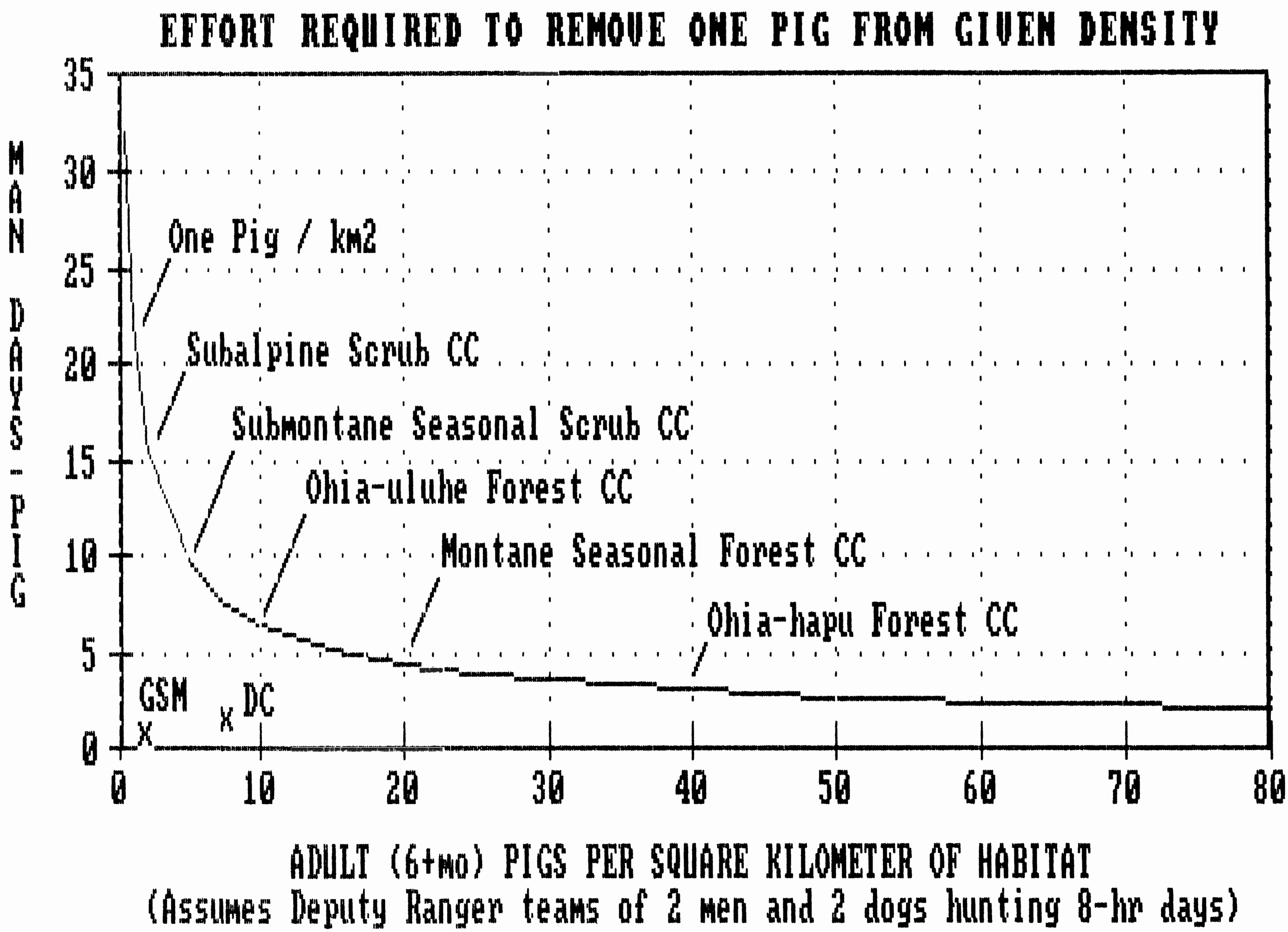
CC carrying capacity?


HVNP PIG MGMT UNIT 11 - POPULATION MODEL
Start actual harvests
PIGLETS
ADULTS 6+mo
ADULT HARVEST (>57%)
Immigrants?
NUMBER
30
25
20
15
10
5
0
63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83
SIMULATION YEAR
(Assumes adult CC = 130 and nonselective adult harvest)


RAIN FOREST - ROOTING DAMAGE-PIG DENSITY RELATIONSHIPS
% GROUND ROOTED
HA - KM2
96
84 63
72 54
60 45
48 36
36 27
24 18
12 9
0
12-MONTH PERIOD
Percent = 1.2 x Density
Ha = 0.9 x Density
6-MONTH PERIOD
Percent = 0.6 x Density
Ha = 0.45 x Density
0 10 20 30 40 50 60 70 80
ADULT (6+MO) PIGS PER SQUARE KILOMETER
(Assumes an adult pig roots 25m2 or a 5x5m area per day)
(Assumes the maximum rootable ground is 75ha per km2)

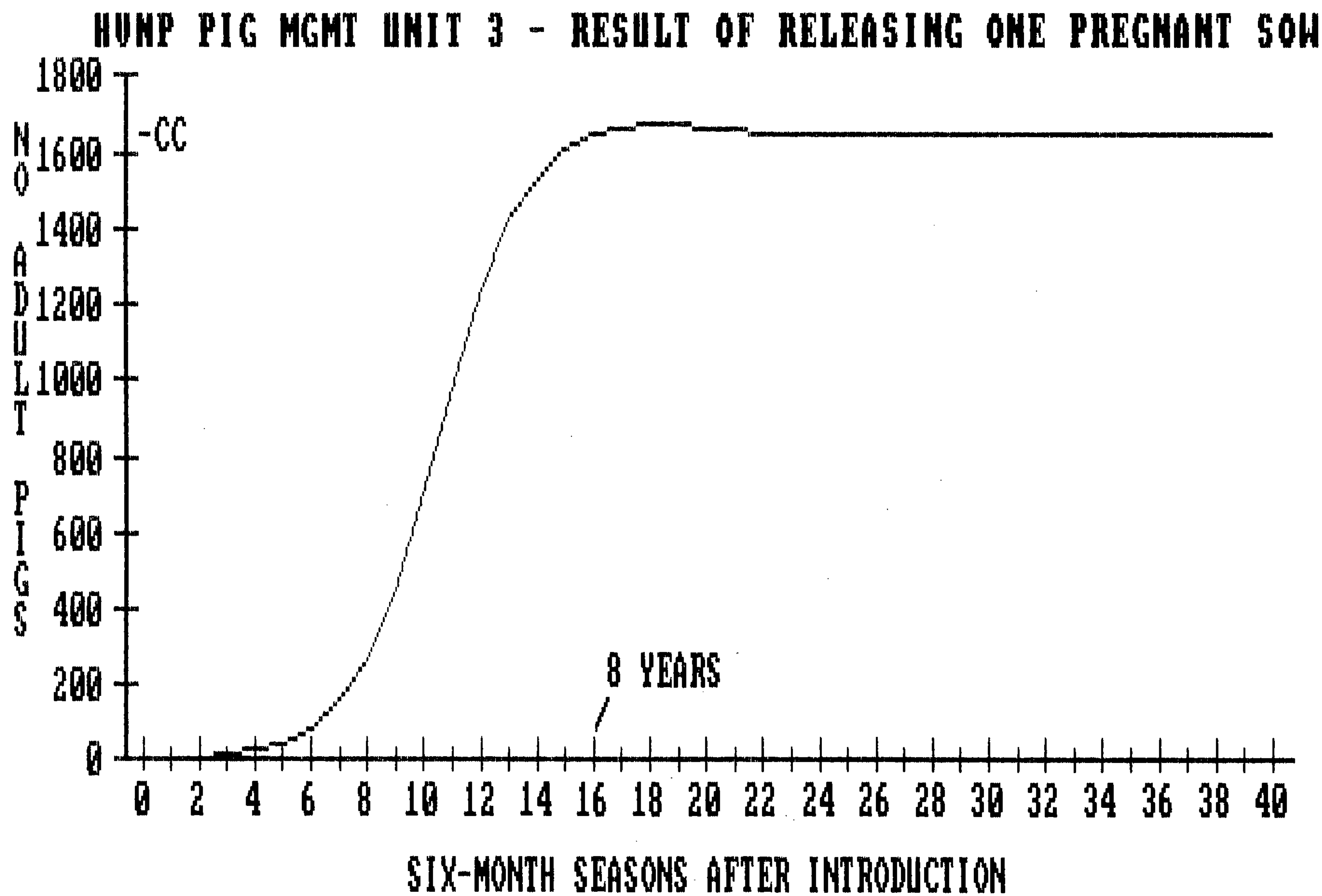
HUNTER ACCESS REQUIRED FOR GIVEN LEVEL OF PIG CONTROL - HVNP



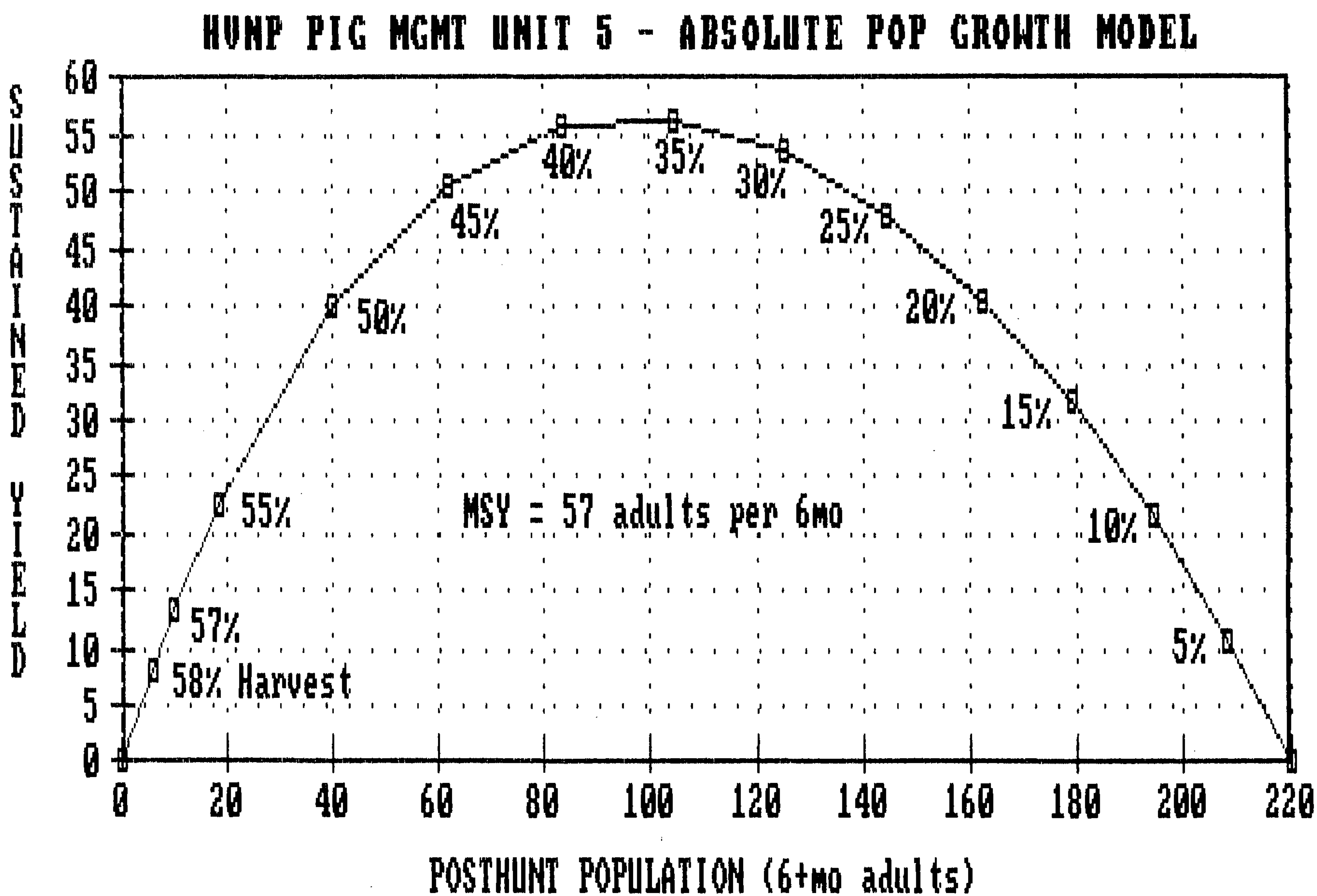


EFFORT REQUIRED TO REMOVE ONE PIG FROM GIVEN DENSITY
MAN DAYS - PIG
35
30
25
20
15
10
5
0
One Pig / km2
Subalpine Scrub CC
Submontane Seasonal Scrub CC
Ohia-uluhe Forest CC
Montane Seasonal Forest CC
Ohia-hapu Forest CC
GSM
X
X
DC
0
10
20
30
40
50
60
70
80
ADULT (6+mo) PIGS PER SQUARE KILOMETER OF HABITAT
(Assumes Deputy Ranger teams of 2 men and 2 dogs hunting 8-hr days)

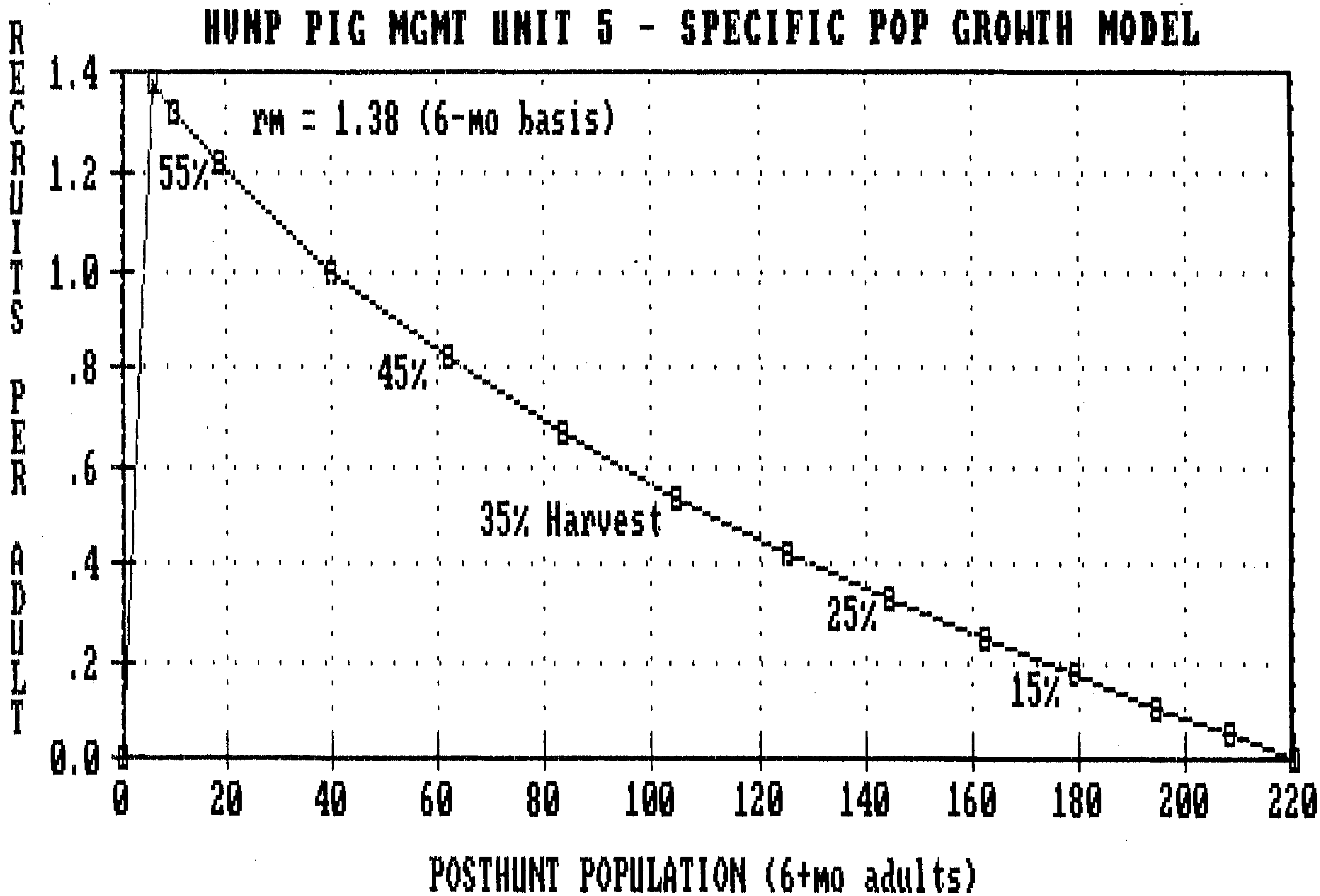
cc = carrying capacity



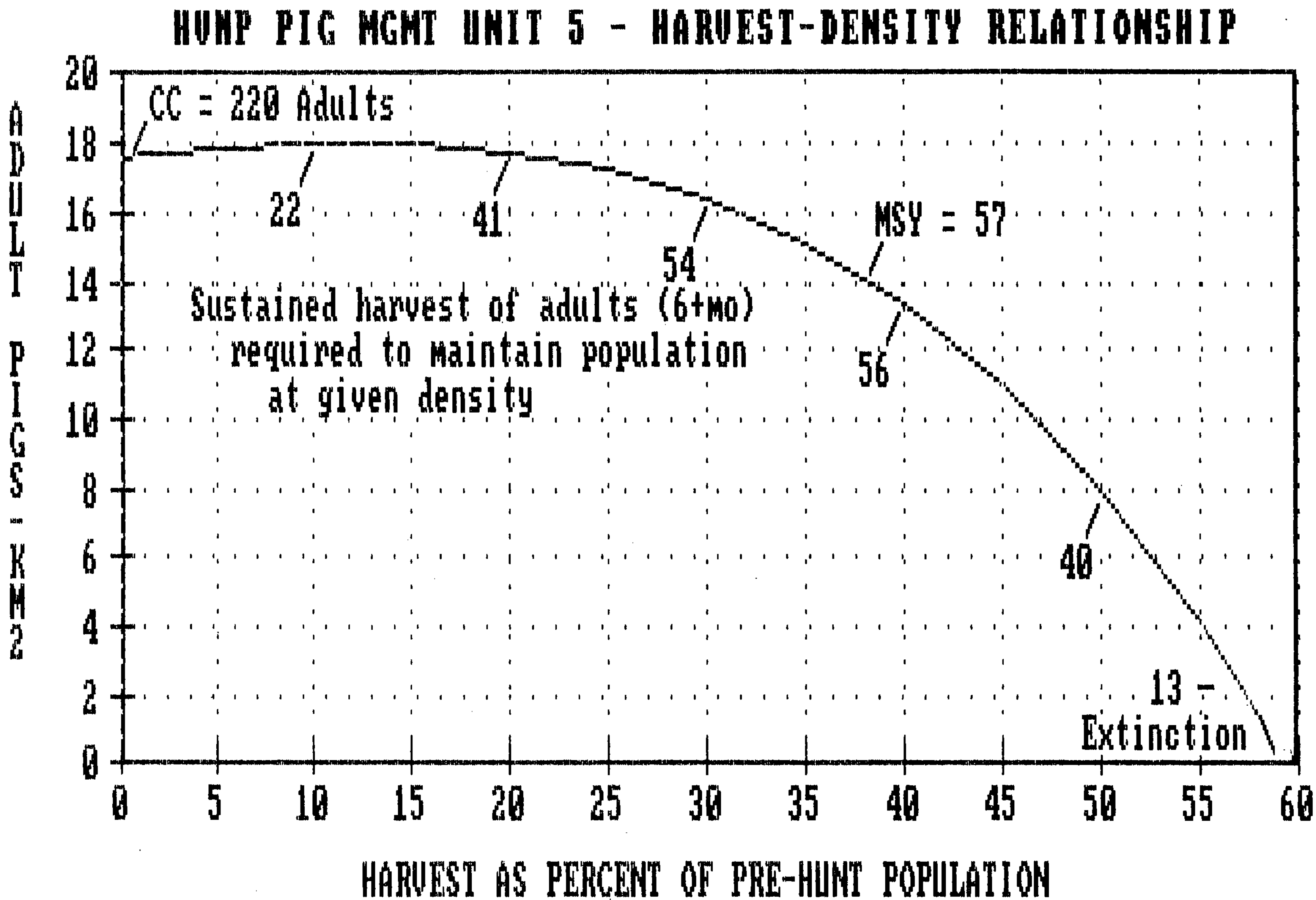
MSY = mean sustained yield



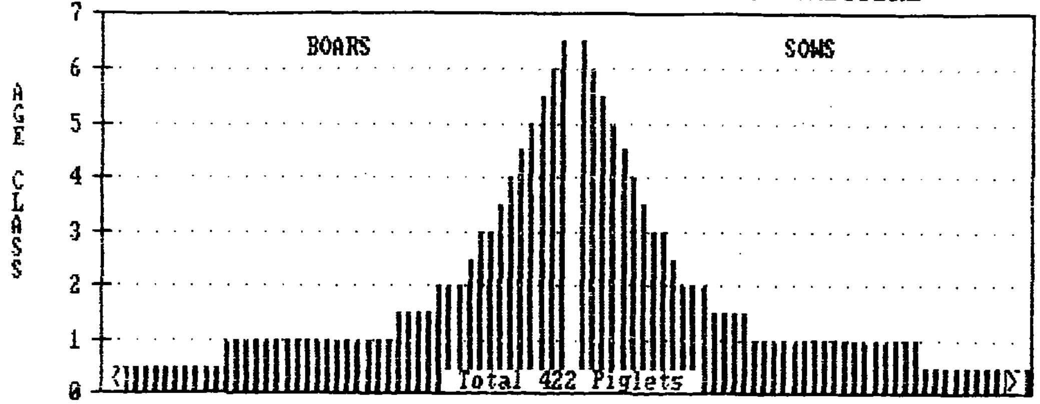
rm = recruit mean ?



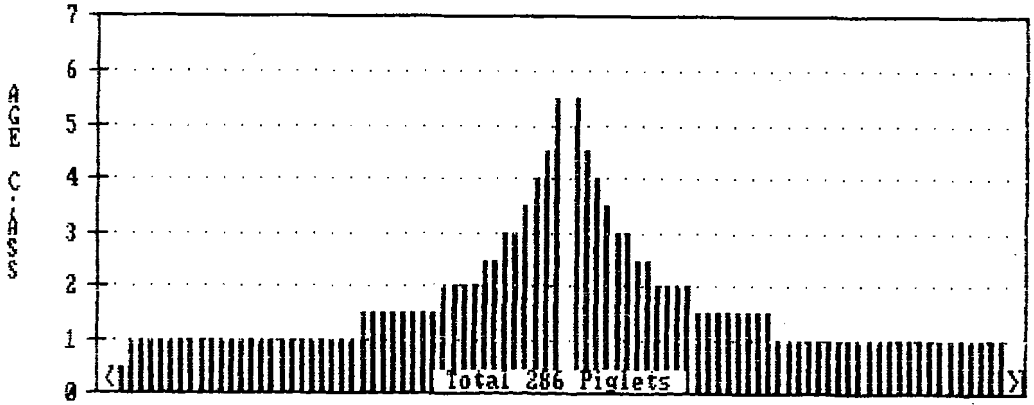
MSY mean sustained yield ?



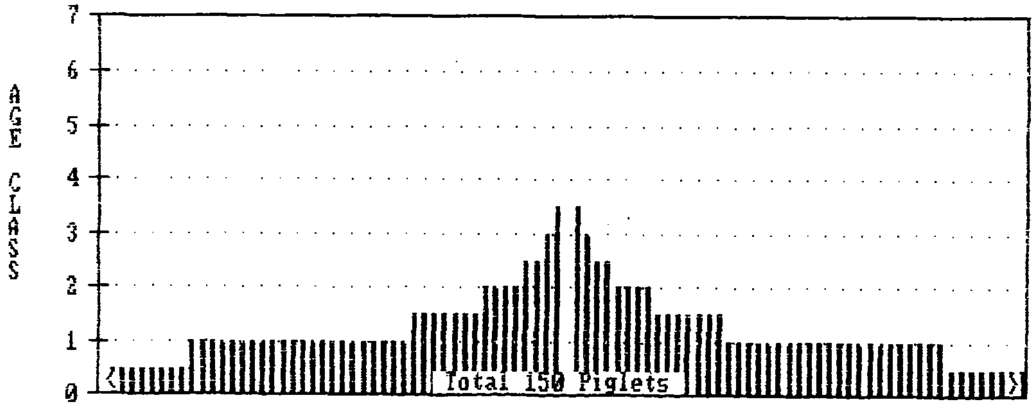
HUMP PIG MGMT UNIT 5 - STABLE AGE STRUCTURE



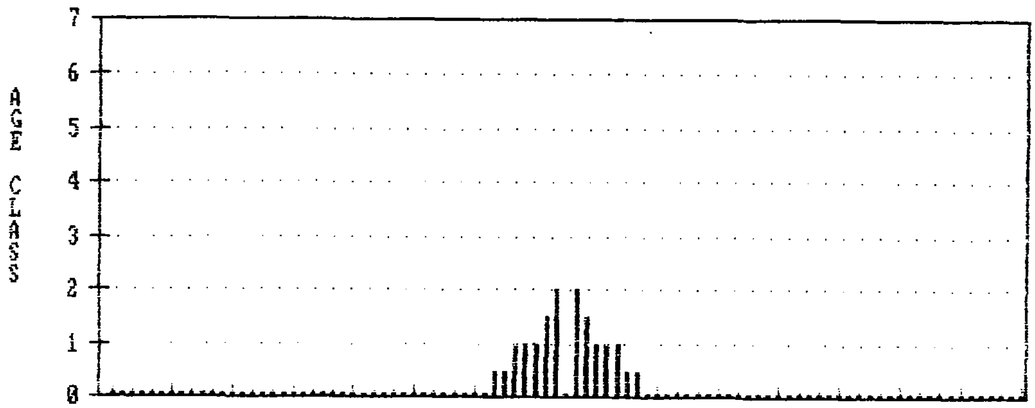
WITH 0% HARVEST



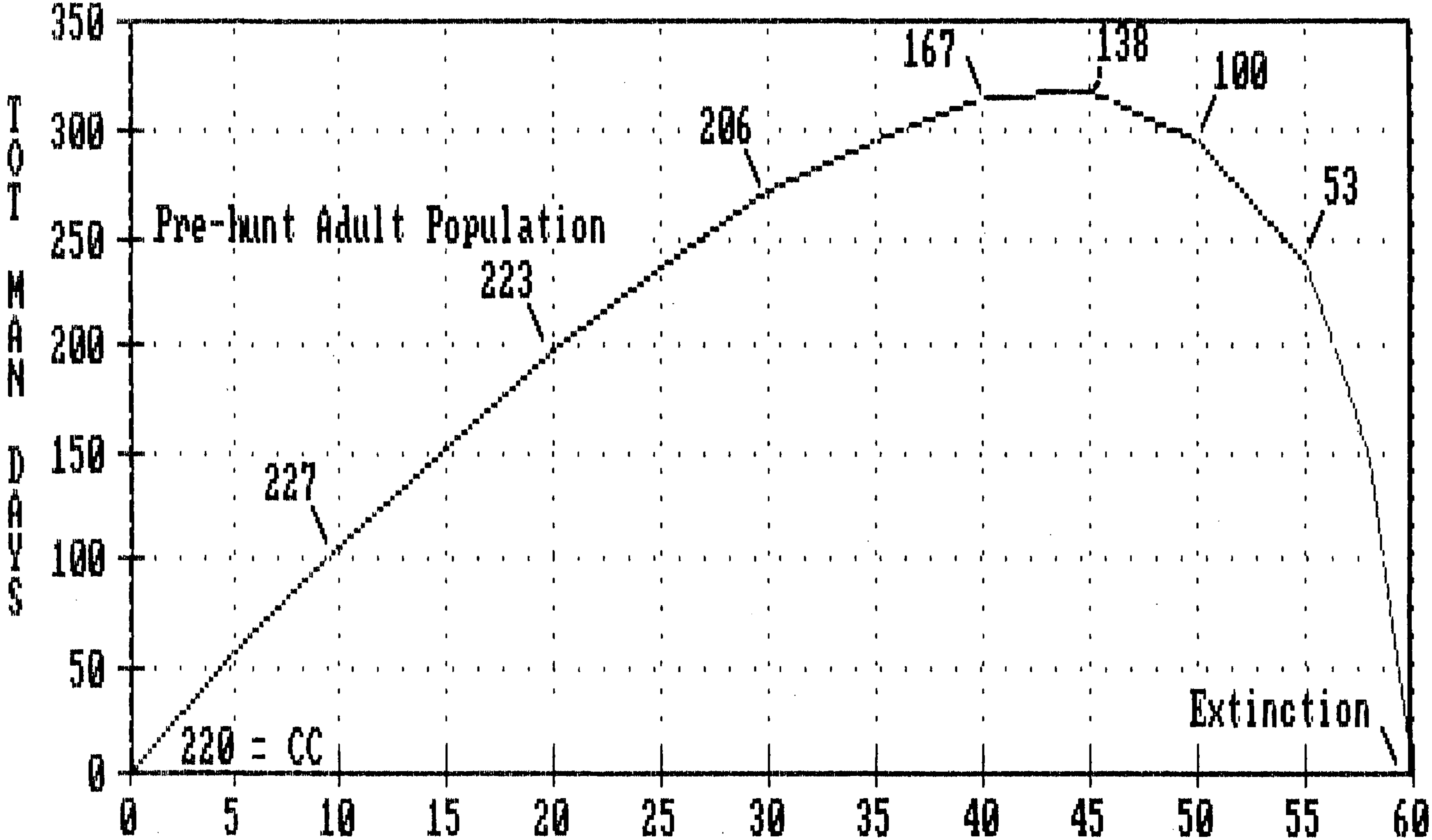
WITH 20% HARVEST



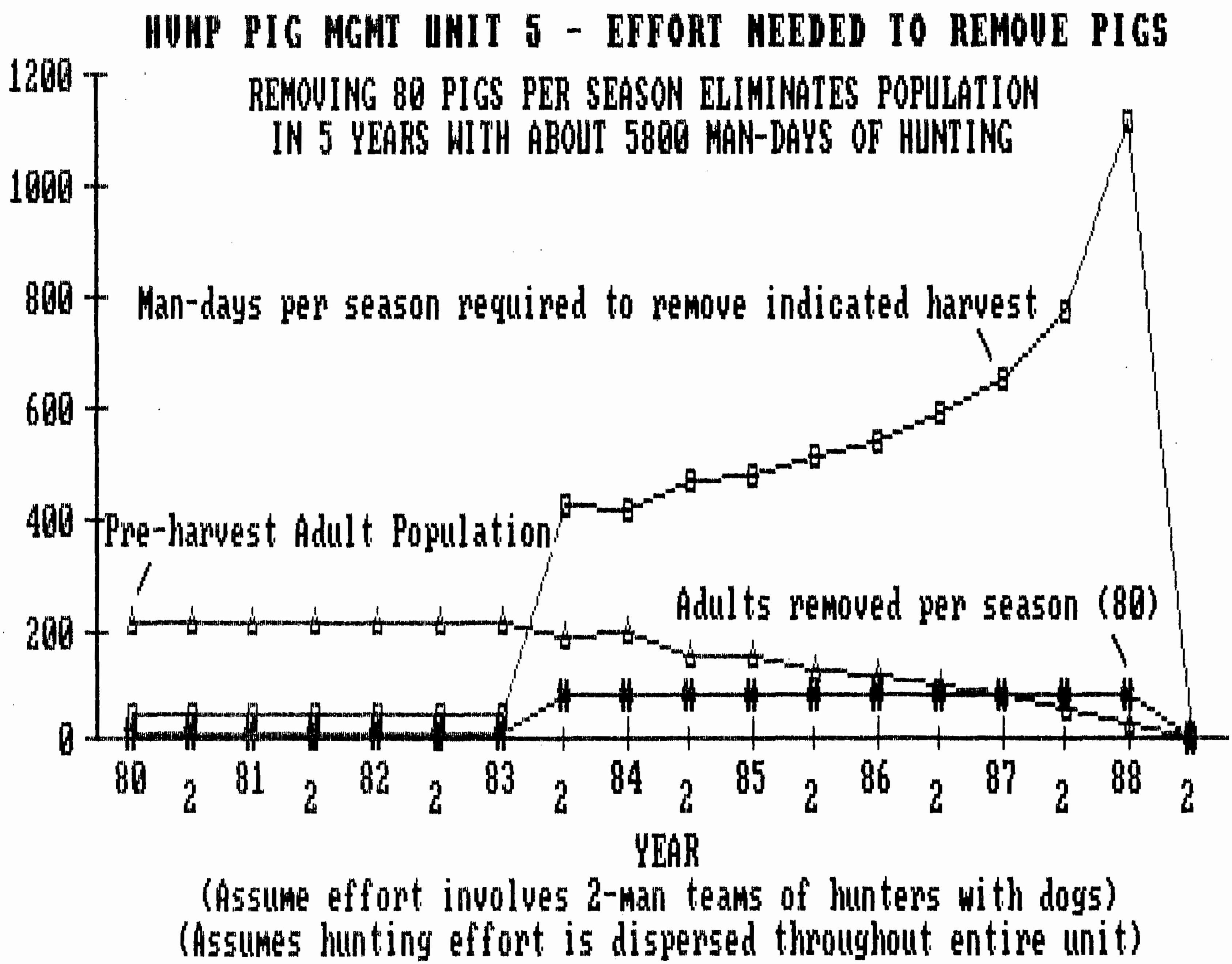
WITH 40% HARVEST



HVNP PIG MGMT UNIT 5 - HUNTING EFFORT TO MAINTAIN GIVEN SY



SUSTAINED YIELD AS PERCENT OF PRE-HUNT ADULT POPULATION
(Assumes hunting teams of 2 men and 2 dogs hunting 8-hr days)
(Assumes total effort is accomplished within a 6-month season)



HVNP PIG MGMT UNIT 5 - EFFORT NEEDED TO REMOVE PIGS
REMOVING 80 PIGS PER SEASON ELIMINATES POPULATION
IN 5 YEARS WITH ABOUT 5800 MAN-DAYS OF HUNTING
1200
1000
800
600
400
200
0
Man-days per season required to remove indicated harvest
Pre-harvest Adult Population
Adults removed per season (80)
80
2
81
2
82
2
83
2
84
2
85
2
86
2
87
2
88
2
YEAR
(Assume effort involves 2-man teams of hunters with dogs)
(Assumes hunting effort is dispersed throughout entire unit)

APPENDIX A.

DATA BASE CONSTRUCTION FOR PIG HUNTING RECORDS

All available data from the files of Hawaii Volcanoes National Park on the number of wild pigs killed over the years were entered into a VISIFILE data base management system (Ewing, R. 1982. VISIFILE user's guide for the IBM Personal Computer. VisiCorp Personal Software, 2895 Zanker Road, San Jose, Ca 95134). Most records were for 1972 to 1983 and included hunting effort by deputy rangers. A separate file was greated for each pig management unit (Table 1) so that plenty of additional space would be available in each file for additional data (each file can hold up to 32,000 records).

TABLE 1

VISIFILE FILE NAME	WILD PIG MANAGEMENT UNIT
HPKU1	MAUNA LOA
HPKU2	KIPUKA KI
HPKU3	OLAA TRACT
HPKU4	KOOKOLAU
HPKU5	PUHIMAU
HPKU6	PUU HULUHULU
HPKU7	KALAPANA
HPKU8	AINAHOU
HPKU9	HILINA PALI
HPKU10	KAU
HPKU11	KILAUEA

The value of having large numbers of records such as the pig kill data stored in a computer data base lies in the computer's ability to sort out data of interest, perform desired calculations rapidly, and display the results in tabular or graphic formats. Updating and resummarizing an ongoing monitoring effort becomes a relatively easy process with a computerized system. It is also easy to revise the data base if errors are detected in the future, and then recalculate summary statistics.

All VISIFILE files for the pig managment units were constructed with an identical format so they could be combined into one large file if desired. There are 12 fields per record (Table 2A,B,C), plus the record number, including eight that require original data and four others filled by calculated field formulas (eg. total kill is the sum of boars, sows, and unknown sex kills). One record represents the data for one month. In the future, it would be easier to enter data from forms designed similarly to the record format. A total of 124 records (months) are now in the data base (November 1972 through February 1983).

All data were double-checked so they should be accurate relative to the original data forms. The accuracy relative to the true hunting effort and true pig kill is unknown; most likely all records are underestimates. If at a future date there is good reason to modify a record it can easily be done. No data were available for fiscal years 1977 through 1979. Therefore, the zeros in these records represent missing data rather than zero values.

If the VISIFILE data base management system is used to store future pig kill records, the information in Tables 1 and 2 is sufficient, in addition to that in the user's manual, to access the data base.

The remainder of APPENDIX A is a hard copy of the data base as it now stands.

TABLE 2

THE THREE PARTS OF THIS TABLE ILLUSTRATE THE FORMAT FOR THE TWELVE FIELDS FOUND IN EACH FILE RECORD. SEE VISIFILE USER'S GUIDE FOR DETAILS.

A.

FILE=HPKU1

FIELD NAME	SIZE	TYPE	PROT	START
A-YR...............	2 ...	N	N ...	2
B-MO...............	2 ...	N	N ...	4
C-GROUPS...........	2 ...	N	N ...	6
D-%SUCCESS.........	3 ...	N	N ...	8
E-HUNTERS..........	3 ...	N	N ...	11
F-BOARS............	3 ...	N	N ...	14
G-SOWS.............	3 ...	N	N ...	17
H-UNKN.............	3 ...	N	N ...	20
I-SEXRATIO.........	3 ...	N	N ...	23
J-TOTKILL..........	4 ...	N	N ...	26
K-KILL/GRP.........	3 ...	N	N ...	30
L-KILL/HNTR........	3 ...	N	N ...	33

CALCULATED FIELD FORMULAS

I=F/G*100:J=F+G+H:K=J/C:L=J/E:

B.

05-29-83 PAGE 1 VISIFILE - FILE DEFINITION 07:49
FILE=HPKU1

FILE NAME PASSWORD
HPKU1

FIELD#	FIELD NAME	SIZE	DATA TYPE	PROTECTION
1	YR	2	N	N
2	MO	2	N	N
3	GROUPS	2	N	N
4	%SUCCESS	3	N	N
5	HUNTERS	3	N	N
6	BOARS	3	N	N
7	SOWS	3	N	N
8	UNKN	3	N	N

DATA TYPE
A=Alpha-numeric
N=Numeric
D=Date as MM/DD/YY
S=Auto-stamp today's date
$=Dollars & cents

PROTECTION
N=None
Y=Update not allowed

F1=Page Forward F2=Page Backward F3=Cancel F4=Done

05-29-83 PAGE 2 VISIFILE - FILE DEFINITION 07:5
FILE=HPKCRATR

FILE NAME PASSWORD
HPKU11

FIELD#	FIELD NAME	SIZE	DATA TYPE	PROTECTION
9	SEXRATIO	3	N	N
10	TOTKILL	4	N	N
11	KILL /GRP	3	N	N
12	KILL /HNTR	3	N	N
13		0	A	N
14		0	A	N
15		0	A	N
16		0	A	N

DATA TYPE
A=Alpha-numeric
N=Numeric
D=Date as MM/DD/YY
S=Auto-stamp today's date
$=Dollars & cents

PROTECTION
N=None
Y=Update not allowed

Characters remaining = 2027

F1=Page Forward F2=Page Backward F3=Cancel F4=Don

C.

05-29-83 Page 1 of 1 VISIFILE - FILE MAINTENANCE RCD# 0/ 124 07:45
FILE: HPKU1

YR MO GROUPS %SUCCESS HUNTERS BOARS SOWS

UNKN SEXRATIO TOTKILL KILL/GRP KILL/HNTR

Add New Data Records
ADD CHANGE DELETE VIEW SELECT-REC INDEX MAP QUIT

05-29-83 Page 1 of 1 VISIFILE - FILE MAINTENANCE RCD# 29/ 124 07:47
FILE: HPKU1

YR 75 MO 3 GROUPS 9 %SUCCESS 11 HUNTERS 42 BOARS 1 SOWS 2

UNKN 0 SEXRATIO 50 TOTKILL 3 KILL/GRP .33 KILL/HNTR .07

View Data Records
ADD CHANGE DELETE VIEW SELECT-REC INDEX MAP QUIT

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	0	0	0	0	0	0	0	0	0	0
2	72	12	0	0	0	0	0	0	0	0	0	0
3	73	1	4	50	10	0	0	9	0	9	2.3	0.9
4	73	2	8	25	29	0	0	4	0	4	0.5	.14
5	73	3	9	33	35	2	1	2	200	5	.56	.14
6	73	4	9	44	28	1	3	2	33	6	.67	.21
7	73	5	8	50	25	1	6	4	17	11	1.4	.44
8	73	6	10	30	24	2	0	3	0	5	0.5	.21
9	73	7	9	11	24	0	0	1	0	1	.11	.04
10	73	8	7	13	22	0	0	1	0	1	.14	.05
11	73	9	11	18	24	0	0	3	0	3	.27	.13
12	73	10	8	12	24	1	0	0	0	1	.13	.04
13	73	11	8	25	25	0	1	2	0	3	.38	.12
14	73	12	8	25	27	0	0	3	0	3	.38	.11
15	74	1	9	0	34	0	0	0	0	0	0	0
16	74	2	9	33	27	2	1	2	200	5	.56	.19
17	74	3	10	0	37	0	0	0	0	0	0	0
18	74	4	8	38	21	1	1	3	100	5	.63	.24
19	74	5	7	14	29	6	0	0	0	6	.86	.21
20	74	6	10	10	39	0	1	0	0	1	0.1	.03
21	74	7	9	22	32	0	0	4	0	4	.44	.13
22	74	8	8	0	23	0	0	0	0	0	0	0
23	74	9	9	22	28	0	0	6	0	6	.67	.21
24	74	10	10	30	25	1	0	2	0	3	0.3	.12
25	74	11	10	10	26	0	0	1	0	1	0.1	.04
26	74	12	9	22	22	1	0	1	0	2	.22	.09
27	75	1	8	38	22	0	0	8	0	8	1	.36
28	75	2	9	0	27	0	0	0	0	0	0	0
29	75	3	9	11	42	1	2	0	50	3	.33	.07
30	75	4	8	0	23	0	0	0	0	0	0	0
31	75	5	9	0	27	0	0	0	0	0	0	0
32	75	6	9	11	20	0	0	2	0	2	.22	0.1
33	75	7	9	11	19	0	0	2	0	2	.22	.11
34	75	8	3	0	6	0	0	0	0	0	0	0
35	75	9	7	14	13	0	1	0	0	1	.14	.08
36	75	10	10	50	20	2	0	6	0	8	0.8	0.4
37	75	11	11	18	21	1	1	0	100	2	.18	.1
38	75	12	10	10	20	0	0	1	0	1	0.1	.05
39	76	1	9	0	19	0	0	0	0	0	0	0
40	76	2	10	0	30	0	0	0	0	0	0	0
41	76	3	7	0	13	0	0	0	0	0	0	0
42	76	4	7	14	15	0	1	0	0	1	.14	.07
43	76	5	9	0	22	0	0	0	0	0	0	0
44	76	6	8	0	12	0	0	0	0	0	0	0
45	76	7	10	10	19	0	0	1	0	1	0.1	.05
46	76	8	8	12	17	1	0	0	0	1	.13	.06
47	76	9	8	0	15	0	0	0	0	0	0	0
48	76	10	11	0	20	0	0	0	0	0	0	0
49	76	11	9	0	19	0	0	0	0	0	0	0
50	76	12	8	12	22	0	1	0	0	1	.13	.05
51	77	1	8	0	23	0	0	0	0	0	0	0
52	77	2	7	14	14	0	1	0	0	1	.14	.07
53	77	3	5	0	9	0	0	0	0	0	0	0
54	77	4	5	0	9	0	0	0	0	0	0	0
55	77	5	6	33	15	1	1	0	100	2	.33	.13
56	77	6	[illegible]	0	[illegible]	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	18	6	31	1	0	0	0	1	.06	.03
82	79	8	12	8	32	1	0	0	0	1	.08	.03
83	79	9	2	0	5	0	0	0	0	0	0	0
84	79	10	11	18	21	2	1	0	200	3	.27	.14
85	79	11	7	0	14	0	0	0	0	0	0	0
86	79	12	0	0	0	0	0	0	0	0	0	0
87	80	1	0	0	0	0	0	0	0	0	0	0
88	80	2	1	0	2	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	2	50	3	1	1	0	100	2	1	.67
91	80	5	1	0	2	0	0	0	0	0	0	0
92	80	6	5	40	11	0	4	1	0	5	1	.45
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	1	100	2	0	0	1	0	1	1	0.5
95	80	9	3	33	4	2	0	0	0	2	.67	0.5
96	80	10	1	0	1	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	0	0	0	0	0	0	0	0	0	0
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	1	100	2	1	1	0	100	2	2	1
104	81	6	0	0	0	0	0	0	0	0	0	0
105	81	7	1	0	1	0	0	0	0	0	0	0
106	81	8	3	33	4	1	1	0	100	2	.67	0.5
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	1	0	2	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	1	100	3	1	0	0	0	1	1	.33
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	0	0	0	0	0	0	0	0	0	0
116	82	6	6	0	14	0	0	0	0	0	0	0
117	82	7	0	0	0	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	0	0	0	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	12	75	36	6	2	12	300	20	1.7	.56
2	72	12	18	67	56	5	7	23	71	35	1.9	.63
3	73	1	13	46	35	1	1	9	100	11	.85	.31
4	73	2	13	38	37	0	0	8	0	8	.62	.22
5	73	3	9	22	21	0	0	4	0	4	.44	.19
6	73	4	13	38	31	9	2	1	450	12	.92	.39
7	73	5	12	33	17	2	4	1	50	7	.58	.41
8	73	6	9	44	15	5	5	1	100	11	1.2	.73
9	73	7	10	0	28	0	0	0	0	0	0	0
10	73	8	7	0	18	0	0	0	0	0	0	0
11	73	9	16	25	40	0	0	6	0	6	.38	.15
12	73	10	12	25	25	2	0	2	0	4	.33	.16
13	73	11	8	50	11	5	2	1	250	8	1	.73
14	73	12	13	38	24	0	0	9	0	9	.69	.38
15	74	1	10	30	23	1	0	7	0	8	0.8	.35
16	74	2	11	18	25	0	2	2	0	4	.36	.16
17	74	3	16	25	37	2	0	5	0	7	.44	.19
18	74	4	7	43	15	0	0	4	0	4	.57	.27
19	74	5	12	25	24	0	2	4	0	6	0.5	.25
20	74	6	15	20	35	1	0	2	0	3	0.2	.09
21	74	7	11	29	22	0	1	1	0	2	.18	.09
22	74	8	10	10	20	0	0	1	0	1	0.1	.05
23	74	9	18	28	35	2	2	3	100	7	.39	0.2
24	74	10	9	33	20	2	1	3	200	6	.67	0.3
25	74	11	18	33	36	3	4	2	75	9	0.5	.25
26	74	12	14	7	45	0	1	0	0	1	.07	.02
27	75	1	11	36	29	0	2	3	0	5	.45	.17
28	75	2	11	27	20	1	0	4	0	5	.45	.25
29	75	3	19	32	39	0	1	5	0	6	.32	.15
30	75	4	12	17	28	0	2	0	0	2	.17	.07
31	75	5	16	19	32	1	1	1	100	3	.19	.09
32	75	6	12	33	29	0	1	9	0	10	.83	.34
33	75	7	5	0	9	0	0	0	0	0	0	0
34	75	8	4	0	8	0	0	0	0	0	0	0
35	75	9	4	25	7	1	0	0	0	1	.25	.14
36	75	10	16	38	30	2	2	8	100	12	.75	0.4
37	75	11	10	40	15	0	1	5	0	6	0.6	0.4
38	75	12	12	8	19	0	0	1	0	1	.08	.05
39	76	1	14	7	28	0	1	0	0	1	.07	.04
40	76	2	11	9	16	0	1	0	0	1	.09	.06
41	76	3	9	33	22	1	3	1	33	5	.56	.23
42	76	4	9	0	13	0	0	0	0	0	0	0
43	76	5	9	11	15	1	0	0	0	1	.11	.07
44	76	6	3	0	10	0	0	0	0	0	0	0
45	76	7	5	20	11	1	0	0	0	1	0.2	.09
46	76	8	2	0	4	0	0	0	0	0	0	0
47	76	9	5	0	19	0	0	0	0	0	0	0
48	76	10	4	0	7	0	0	0	0	0	0	0
49	76	11	1	0	1	0	0	0	0	0	0	0
50	76	12	5	20	8	0	1	0	0	1	0.2	.13
51	77	1	14	21	24	2	2	0	100	4	.29	.17
52	77	2	6	50	19	2	2	0	100	4	.67	.21
53	77	3	10	30	31	2	2	0	100	4	0.4	.13
54	77	4	6	17	24	2	0	0	0	2	.33	.08
55	77	5	15	40	30	2	2	4	100	8	.53	.27

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	8	12	11	0	2	0	0	2	.25	.18
82	79	8	15	20	23	3	8	0	38	11	.73	.48
83	79	9	2	0	2	0	0	0	0	0	0	0
84	79	10	6	33	12	0	4	0	0	4	.67	.33
85	79	11	4	0	5	0	0	0	0	0	0	0
86	79	12	12	17	23	1	1	0	100	2	.17	.09
87	80	1	6	67	11	0	2	4	0	6	1	.55
88	80	2	5	20	6	0	1	0	0	1	0.2	.17
89	80	3	5	60	10	3	1	0	300	4	0.8	0.4
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	5	60	8	1	1	1	100	3	0.6	.38
96	80	10	1	0	2	0	0	0	0	0	0	0
97	80	11	5	80	10	2	1	2	200	5	1	0.5
98	80	12	5	20	11	0	0	1	0	1	0.2	.09
99	81	1	2	0	4	0	0	0	0	0	0	0
100	81	2	1	0	1	0	0	0	0	0	0	0
101	81	3	3	100	6	0	0	4	0	4	1.3	.67
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	4	50	7	1	3	0	33	4	1	.57
104	81	6	5	20	9	0	0	1	0	1	0.2	.11
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	4	0	7	0	0	0	0	0	0	0
108	81	10	4	50	7	2	1	0	200	3	.75	.43
109	81	11	2	0	4	0	0	0	0	0	0	0
110	81	12	3	67	7	1	0	2	0	3	1	.43
111	82	1	5	60	10	5	2	0	250	7	1.4	0.7

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	3	33	6	1	0	0	0	1	.33	.17
114	82	4	5	80	11	2	4	0	50	6	1.2	.55
115	82	5	9	11	21	1	0	0	0	1	.11	.05
116	82	6	1	100	3	0	1	0	0	1	1	.33
117	82	7	2	50	4	2	0	0	0	2	1	0.5
118	82	8	6	33	10	0	1	1	0	2	.33	0.2
119	82	9	12	25	31	2	3	0	67			
										5	.42	.16
120	82	10	10	50	30	5	3	0	0	8	0.8	.27
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	1	100	2	2	0	0	0	2	2	1
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	0	0	0	0	0	0	0	0	0	0
2	72	12	0	0	0	0	0	0	0	0	0	0
3	73	1	0	0	0	0	0	0	0	0	0	0
4	73	2	0	0	0	0	0	0	0	0	0	0
5	73	3	0	0	0	0	0	0	0	0	0	0
6	73	4	0	0	0	0	0	0	0	0	0	0
7	73	5	0	0	0	0	0	0	0	0	0	0
8	73	6	0	0	0	0	0	0	0	0	0	0
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	0	0	0	0	0	0	0	0	0	0
11	73	9	0	0	0	0	0	0	0	0	0	0
12	73	10	0	0	0	0	0	0	0	0	0	0
13	73	11	0	0	0	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	0	0	0	0	0	0	0	0	0	0
17	74	3	0	0	0	0	0	0	0	0	0	0
18	74	4	0	0	0	0	0	0	0	0	0	0
19	74	5	0	0	0	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	0	0	0	0	0	0	0	0	0	0
22	74	8	0	0	0	0	0	0	0	0	0	0
23	74	9	0	0	0	0	0	0	0	0	0	0
24	74	10	0	0	0	0	0	0	0	0	0	0
25	74	11	0	0	0	0	0	0	0	0	0	0
26	74	12	0	0	0	0	0	0	0	0	0	0
27	75	1	0	0	0	0	0	0	0	0	0	0
28	75	2	0	0	0	0	0	0	0	0	0	0
29	75	3	0	0	0	0	0	0	0	0	0	0
30	75	4	0	0	0	0	0	0	0	0	0	0
31	75	5	0	0	0	0	0	0	0	0	0	0
32	75	6	0	0	0	0	0	0	0	0	0	0
33	75	7	0	0	0	0	0	0	0	0	0	0
34	75	8	0	0	0	0	0	0	0	0	0	0
35	75	9	0	0	0	0	0	0	0	0	0	0
36	75	10	0	0	0	0	0	0	0	0	0	0
37	75	11	0	0	0	0	0	0	0	0	0	0
38	75	12	0	0	0	0	0	0	0	0	0	0
39	76	1	0	0	0	0	0	0	0	0	0	0
40	76	2	0	0	0	0	0	0	0	0	0	0
41	76	3	0	0	0	0	0	0	0	0	0	0
42	76	4	0	0	0	0	0	0	0	0	0	0
43	76	5	0	0	0	0	0	0	0	0	0	0
44	76	6	0	0	0	0	0	0	0	0	0	0
45	76	7	0	0	0	0	0	0	0	0	0	0
46	76	8	1	0	2	0	0	0	0	0	0	0
47	76	9	2	0	4	0	0	0	0	0	0	0
48	76	10	2	50	2	0	1	0	0	1	0.5	0.5
49	76	11	1	0	2	0	0	0	0	0	0	0
50	76	12	0	0	0	0	0	0	0	0	0	0
51	77	1	0	0	0	0	0	0	0	0	0	0
52	77	2	0	0	0	0	0	0	0	0	0	0
53	77	3	0	0	0	0	0	0	0	0	0	0
54	77	4	0	0	0	0	0	0	0	0	0	0
55	77	5	0	0	0	0	0	0	0	0	0	0
56	77	6	1	0	1	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	2	0	3	0	0	0	0	0	0	0
59	77	9	1	0	1	0	0	0	0	0	0	0
60	77	10	2	100	3	0	3	0	0	3	1.5	1
61	77	11	3	100	5	3	1	0	300	4	1.3	0.8
62	77	12	3	33	7	1	0	0	0	1	.33	.14
63	78	1	4	75	15	2	2	0	100	4	1	.27
64	78	2	4	100	18	4	0	0	0	4	1	.22
65	78	3	4	25	14	0	1	0	0	1	.25	.07
66	78	4	6	50	19	4	1	0	400	5	.83	.26
67	78	5	1	0	2	0	0	0	0	0	0	0
68	78	6	1	0	3	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	1	0	2	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	2	0	6	0	0	0	0	0	0	0
73	78	11	1	100	4	0	1	0	0	1	1	.25
74	78	12	1	0	2	0	0	0	0	0	0	0
75	79	1	1	0	2	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	1	0	1	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	1	0	1	0	0	0	0	0	0	0
81	79	7	0	0	0	0	0	0	0	0	0	0
82	79	8	1	0	2	0	0	0	0	0	0	0
83	79	9	2	100	4	1	2	0	50	3	1.5	.75
84	79	10	5	40	11	1	1	0	100	2	0.4	.18
85	79	11	2	50	3	1	0	0	0	1	0.5	.33
86	79	12	1	0	2	0	0	0	0	0	0	0
87	80	1	0	0	0	0	0	0	0	0	0	0
88	80	2	1	0	1	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	0	0	0	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	2	0	4	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	2	50	2	0	0	1	0	1	0.5	0.5
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	1	0	3	0	0	0	0	0	0	0
104	81	6	0	0	0	0	0	0	0	0	0	0
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	2	50	3	1	0	0	0	1	0.5	.33
107	81	9	1	0	2	0	0	0	0	0	0	0
108	81	10	2	50	4	0	1	0	0	1	0.5	.25
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	1	100	2	0	0	1	0	1	1	0.5
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	5	80	5	4	3	0	0	7	1.4	1.4
115	82	5	8	50	9	5	0	0	0	5	.63	.56
116	82	6	9	44	14	3	1	2	300	6	.67	.43
117	82	7	3	67	4	2	2	0	100	4	1.3	1
118	82	8	2	100	3	3	2	0	150	5	2.5	1.7
119	82	9	4	25	12	1	0	0	0	1	.25	.08
120	82	10	2	0	4	0	0	0	0	0	0	0
121	82	11	10	50	15	5	3	0	0	8	0.8	.53
122	82	12	4	25	4	1	1	0	100	2	0.5	0.5
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	6	83	18	0	1	11	0	12	2	.67
2	72	12	5	20	12	1	2	0	50	3	0.6	.25
3	73	1	5	0	19	0	0	0	0	0	0	0
4	73	2	1	0	3	0	0	0	0	0	0	0
5	73	3	1	0	3	0	0	0	0	0	0	0
6	73	4	3	0	6	0	0	0	0	0	0	0
7	73	5	1	0	3	0	0	0	0	0	0	0
8	73	6	1	0	2	0	0	0	0	0	0	0
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	3	67	4	0	0	2	0	2	.67	0.5
11	73	9	0	0	0	0	0	0	0	0	0	0
12	73	10	0	0	0	0	0	0	0	0	0	0
13	73	11	1	0	3	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	0	0	0	0	0	0	0	0	0	0
17	74	3	2	0	4	0	0	0	0	0	0	0
18	74	4	0	0	0	0	0	0	0	0	0	0
19	74	5	0	0	0	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	1	0	1	0	0	0	0	0	0	0
22	74	8	1	0	2	0	0	0	0	0	0	0
23	74	9	3	33	5	2	0	0	0	2	.67	0.4
24	74	10	4	25	5	0	1	0	0	1	.25	0.2
25	74	11	5	60	8	1	1	2	100	4	0.8	0.5
26	74	12	4	25	7	0	0	1	0	1	.25	.14
27	75	1	1	100	1	0	0	2	0	2	2	2
28	75	2	3	0	9	0	0	0	0	0	0	0
29	75	3	3	33	5	0	0	2	0	2	.67	0.4
30	75	4	5	40	8	1	1	1	100	3	0.6	.38
31	75	5	4	25	8	0	0	1	0	1	.25	.13
32	75	6	2	0	2	0	0	0	0	0	0	0
33	75	7	0	0	0	0	0	0	0	0	0	0
34	75	8	1	100	1	0	0	1	0	1	1	1
35	75	9	2	100	3	1	0	1	0	2	1	.67
36	75	10	3	33	6	0	0	1	0	1	.33	.17
37	75	11	1	0	1	0	0	0	0	0	0	0
38	75	12	1	0	1	0	0	0	0	0	0	0
39	76	1	3	0	6	0	0	0	0	0	0	0
40	76	2	1	100	3	0	1	0	0	1	1	.33
41	76	3	0	0	0	0	0	0	0	0	0	0
42	76	4	2	0	4	0	0	0	0	0	0	0
43	76	5	0	0	0	0	0	0	0	0	0	0
44	76	6	2	0	5	0	0	0	0	0	0	0
45	76	7	2	0	5	0	0	0	0	0	0	0
46	76	8	2	0	2	0	0	0	0	0	0	0
47	76	9	0	0	0	0	0	0	0	0	0	0
48	76	10	3	33	5	0	1	0	0	1	.33	0.2
49	76	11	3	67	3	1	2	0	50	3	1	1
50	76	12	2	0	2	0	0	0	0	0	0	0
51	77	1	1	100	1	0	2	0	0	2	2	2
52	77	2	1	0	1	0	0	0	0	0	0	0
53	77	3	0	0	0	0	0	0	0	0	0	0
54	77	4	3	67	3	0	2	0	0	2	.67	.67
55	77	5	2	0	4	0	0	0	0	0	0	0
56	77	6	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	1	0	1	0	0	0	0	0	0	0
82	79	8	1	0	1	0	0	0	0	0	0	0
83	79	9	1	0	1	0	0	0	0	0	0	0
84	79	10	0	0	0	0	0	0	0	0	0	0
85	79	11	1	0	1	0	0	0	0	0	0	0
86	79	12	0	0	0	0	0	0	0	0	0	0
87	80	1	1	0	2	0	0	0	0	0	0	0
88	80	2	2	50	2	1	0	0	0	1	0.5	0.5
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	1	0	2	0	0	0	0	0	0	0
96	80	10	3	33	9	0	0	2	0	2	.67	.22
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	1	0	1	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	0	0	0	0	0	0	0	0	0	0
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	1	0	2	0	0	0	0	0	0	0
104	81	6	1	0	2	0	0	0	0	0	0	0
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	1	0	2	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	1	0	1	0	0	0	0	0	0	0
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	1	0	2	0	0	0	0	0	0	0
116	82	6	0	0	0	0	0	0	0	0	0	0
117	82	7	0	0	0	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	1	100	3	1	0	0	0	1	1	.33
120	82	10	1	0	2	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	6	100	18	3	2	7	150	12	2	.67
2	72	12	6	17	14	0	0	2	0	2	.33	.14
3	73	1	4	50	10	0	0	3	0	3	.75	0.3
4	73	2	5	40	14	0	0	3	0	3	0.6	.21
5	73	3	4	75	8	1	0	4	0	5	1.3	.63
6	73	4	2	100	4	1	1	0	100	2	1	0.5
7	73	5	4	50	11	2	1	0	200	3	.75	.27
8	73	6	3	33	6	0	0	2	0	2	.67	.33
9	73	7	1	100	4	0	0	1	0	1	1	.25
10	73	8	2	0	5	0	0	0	0	0	0	0
11	73	9	5	40	11	0	0	2	0	2	0.4	.18
12	73	10	2	0	5	0	0	0	0	0	0	0
13	73	11	2	0	4	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	1	100	2	2	2	0	100	4	4	2
16	74	2	3	67	6	0	0	3	0	3	1	0.5
17	74	3	7	43	15	2	2	2	100	6	.86	0.4
18	74	4	2	50	4	0	0	1	0	1	0.5	.25
19	74	5	1	0	2	0	0	0	0	0	0	0
20	74	6	3	67	5	1	0	1	0	2	.67	0.4
21	74	7	5	20	10	0	0	1	0	1	0.2	0.1
22	74	8	5	60	13	0	0	4	0	4	0.8	.31
23	74	9	4	25	6	0	1	0	0	1	.25	.17
24	74	10	6	33	8	1	0	1	0	2	.33	.25
25	74	10	8	25	15	0	1	2	0	3	.38	0.2
26	74	12	5	0	9	0	0	0	0	0	0	0
27	75	1	4	50	12	0	0	3	0	3	.75	.25
28	75	2	6	67	9	1	2	1	50	4	.67	.44
29	75	3	9	0	17	0	0	0	0	0	0	0
30	75	4	6	33	10	0	0	2	0	2	.33	0.2
31	75	5	8	12	20	0	1	0	0	1	.13	.05
32	75	6	9	33	16	0	2	5	0	7	.78	.44
33	75	7	6	17	8	1	0	0	0	1	.17	.13
34	75	8	4	25	5	1	0	0	0	1	.25	0.2
35	75	9	4	25	5	0	0	1	0	1	.25	0.2
36	75	10	6	0	10	0	0	0	0	0	0	0
37	75	11	3	0	5	0	0	0	0	0	0	0
38	75	12	5	40	9	1	1	0	100	2	0.4	.22
39	76	1	7	43	11	2	3	0	67	5	.71	.45
40	76	2	4	75	7	0	0	3	0	3	.75	.43
41	76	3	6	12	10	1	0	0	0	1	.17	0.1
42	76	4	6	33	10	0	2	0	0	2	.33	0.2
43	76	5	4	25	7	1	0	0	0	1	.25	.14
44	76	6	2	0	4	0	0	0	0	0	0	0
45	76	7	2	50	2	0	0	1	0	1	0.5	0.5
46	76	8	4	25	5	1	1	0	100	2	0.5	0.4
47	76	9	6	0	10	0	0	0	0	0	0	0
48	76	10	5	100	5	4	3	0	0	7	1.4	1.4
49	76	11	5	80	11	4	2	0	200	6	1.2	.55
50	76	12	4	0	4	0	0	0	0	0	0	0
51	77	1	3	0	5	0	0	0	0	0	0	0
52	77	2	5	60	6	5	1	0	500	6	1.2	1
53	77	3	5	20	6	1	0	0	0	1	0.2	.17
54	77	4	7	57	12	3	3	0	100	6	.86	0.5
55	77	5	2	50	2	1	0	0	0	1	0.5	0.5
56	77	6	3	0	4	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	4	25	8	1	0	0	0	1	.25	.13
82	79	8	5	0	6	0	0	0	0	0	0	0
83	79	9	2	0	2	0	0	0	0	0	0	0
84	79	10	5	20	8	1	0	0	0	1	0.2	.13
85	79	11	10	40	12	5	0	0	0	5	0.5	.42
86	79	12	8	12	9	1	1	0	100	2	.25	.22
87	80	1	5	20	8	1	0	0	0	1	0.2	.13
88	80	2	5	60	8	2	1	0	200	3	0.6	.38
89	80	3	1	100	1	1	0	0	0	1	1	1
90	80	4	2	100	2	0	1	1	0	2	1	1
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	2	0	2	0	0	0	0	0	0	0
95	80	9	5	60	13	1	0	2	0	3	0.6	.23
96	80	10	10	40	26	0	0	7	0	7	0.7	.27
97	80	11	5	60	12	0	1	2	0	3	0.6	.25
98	80	12	6	33	14	0	0	2	0	2	.33	.14
99	81	1	11	27	20	2	1	1	200	4	.36	0.2
100	81	2	1	0	2	0	0	0	0	0	0	0
101	81	3	2	50	4	0	0	1	0	1	0.5	.25
102	81	4	3	67	6	0	2	0	0	2	.67	.33
103	81	5	3	33	6	0	1	0	0	1	.33	.17
104	81	6	2	50	4	0	0	1	0	1	0.5	.25
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	1	0	2	0	0	0	0	0	0	0
107	81	9	1	100	5	0	1	0	0	1	1	0.2
108	81	10	5	60	15	1	2	0	50	3	0.6	0.2
109	81	11	6	50	17	2	0	1	0	3	0.5	.18
110	81	12	2	50	7	0	2	0	0	2	1	.29
111	82	1	3	100	8	3	1	0	300	4	1.3	0.5
112	82	2	3	33	10	0	1	0	0	1	.33	0.1

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	4	50	6	2	0	0	0	2	0.5	.33
114	82	4	1	0	3	0	0	0	0	0	0	0
115	82	5	3	33	7	1	0	0	0	1	.33	.14
116	82	6	4	75	15	2	1	2	200	5	1.3	.33
117	82	7	1	100	5	0	0	2	0	2	2	0.4
118	82	8	4	0	8	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	0	0	0	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	3	33	7	0	0	2	0	2	.67	.29
2	72	12	5	60	12	0	0	6	0	6	1.2	0.5
3	73	1	2	50	6	0	0	1	0	1	0.5	.17
4	73	2	1	0	2	0	0	0	0	0	0	0
5	73	3	0	0	0	0	0	0	0	0	0	0
6	73	4	1	100	2	1	3	0	33	4	4	2
7	73	5	1	0	2	0	0	0	0	0	0	0
8	73	6	3	33	7	0	0	2	0	2	.67	.29
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	0	0	0	0	0	0	0	0	0	0
11	73	9	1	100	2	0	0	1	0	1	1	0.5
12	73	10	1	0	2	0	0	0	0	0	0	0
13	73	11	2	50	4	0	0	1	0	1	0.5	.25
14	73	12	2	0	4	0	0	0	0	0	0	0
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	0	0	0	0	0	0	0	0	0	0
17	74	3	0	0	0	0	0	0	0	0	0	0
18	74	4	0	0	0	0	0	0	0	0	0	0
19	74	5	0	0	0	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	0	0	0	0	0	0	0	0	0	0
22	74	8	0	0	0	0	0	0	0	0	0	0
23	74	9	0	0	0	0	0	0	0	0	0	0
24	74	10	1	0	5	0	0	0	0	0	0	0
25	74	11	2	0	2	0	0	0	0	0	0	0
26	74	12	1	0	2	0	0	0	0	0	0	0
27	75	1	2	0	4	0	0	0	0	0	0	0
28	75	2	1	100	3	0	0	1	0	1	1	.33
29	75	3	2	50	3	1	2	0	50	3	1.5	1
30	75	4	4	75	6	0	1	3	0	4	1	.67
31	75	5	5	60	14	1	0	4	0	5	1	.36
32	75	6	5	40	8	1	0	3	0	4	0.8	0.5
33	75	7	2	0	3	0	0	0	0	0	0	0
34	75	8	3	0	5	0	0	0	0	0	0	0
35	75	9	3	33	6	0	0	3	0	3	1	0.5
36	75	10	1	0	2	0	0	0	0	0	0	0
37	75	11	3	0	6	0	0	0	0	0	0	0
38	75	12	0	0	0	0	0	0	0	0	0	0
39	76	1	4	0	8	0	0	0	0	0	0	0
40	76	2	2	0	3	0	0	0	0	0	0	0
41	76	3	4	25	6	1	0	0	0	1	.25	.17
42	76	4	4	0	8	0	0	0	0	0	0	0
43	76	5	3	67	6	2	2	0	100	4	1.3	.67
44	76	6	3	0	5	0	0	0	0	0	0	0
45	76	7	2	0	2	0	0	0	0	0	0	0
46	76	8	2	0	2	0	0	0	0	0	0	0
47	76	9	1	100	2	0	1	0	0	1	1	0.5
48	76	10	4	50	4	2	1	0	200	3	.75	.75
49	76	11	3	33	5	1	1	0	100	2	.67	0.4
50	76	12	0	0	0	0	0	0	0	0	0	0
51	77	1	1	0	2	0	0	0	0	0	0	0
52	77	2	2	0	4	0	0	0	0	0	0	0
53	77	3	1	0	3	0	0	0	0	0	0	0
54	77	4	2	0	2	0	0	0	0	0	0	0
55	77	5	2	50	2	0	1	0	0	1	0.5	0.5
56	77	6	1	100	1	1	1	0	100	2	2	2

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	4	0	6	0	0	0	0	0	0	0
82	79	8	1	0	2	0	0	0	0	0	0	0
83	79	9	1	0	1	0	0	0	0	0	0	0
84	79	10	1	0	1	0	0	0	0	0	0	0
85	79	11	2	0	3	0	0	0	0	0	0	0
86	79	12	0	0	0	0	0	0	0	0	0	0
87	80	1	0	0	0	0	0	0	0	0	0	0
88	80	2	0	0	0	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	0	0	0	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	1	0	1	0	0	0	0	0	0	0
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	0	0	0	0	0	0	0	0	0	0
104	81	6	0	0	0	0	0	0	0	0	0	0
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	0	0	0	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	0	0	0	0	0	0	0	0	0	0
116	82	6	0	0	0	0	0	0	0	0	0	0
117	82	7	2	50	4	0	0	1	0	1	0.5	.25
118	82	8	1	0	2	0	0	0	0	0	0	0
119	82	9	1	0	4	0	0	0	0	0	0	0
120	82	10	1	100	2	0	0	1	0	1	1	0.5
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SES	TOT	KIL	KIL
1	72	11	7	29	23	1	1	0	100	2	.29	.09
2	72	12	7	71	29	6	8	0	75	14	2	.48
3	73	1	2	100	4	1	0	8	0	9	4.5	2.3
4	73	2	9	78	30	7	7	6	100	20	2.2	.67
5	73	3	3	100	4	3	4	1	75	8	2.7	2
6	73	4	7	100	34	12	15	0	80	27	3.9	.79
7	73	5	6	100	25	8	6	0	0	14	2.3	.56
8	73	6	7	57	14	4	4	2	100	10	1.4	.71
9	73	7	4	50	7	4	2	0	200	6	1.5	.86
10	73	8	1	0	3	0	0	0	0	0	0	0
11	73	9	3	67	6	4	2	0	200	6	2	1
12	73	10	3	0	6	0	0	0	0	0	0	0
13	73	11	3	67	8	3	2	0	150	5	1.7	.63
14	73	12	5	80	10	4	4	0	100	8	1.6	0.8
15	74	1	2	50	3	0	2	0	0	2	1	.67
16	74	2	3	67	6	0	1	4	0	5	1.7	.83
17	74	3	5	80	6	6	4	0	150	10	2	1.7
18	74	4	2	50	4	1	3	0	33	4	2	1
19	74	5	5	100	14	5	6	4	83	15	3	1.1
20	74	6	6	67	6	2	4	0	50	6	1	1
21	74	7	3	67	7	3	0	0	0	3	1	.43
22	74	8	8	63	15	5	4	0	125	9	1.1	0.6
23	74	9	4	75	10	4	0	0	0	4	1	0.4
24	74	10	3	67	5	2	1	0	200	3	1	0.6
25	74	11	5	60	10	3	3	0	100	6	1.2	0.6
26	74	12	7	71	13	1	4	0	25	5	.71	.38
27	75	1	9	78	24	11	3	0	0	14	1.6	.58
28	75	2	6	50	14	0	2	3	0	5	.83	.36
29	75	3	5	20	16	2	0	0	0	2	0.4	.13
30	75	4	5	20	11	0	1	0	0	1	0.2	.09
31	75	5	4	50	9	4	6	0	67	10	2.5	1.1
32	75	6	6	33	14	2	3	0	67	5	.83	.36
33	75	7	4	0	14	0	0	0	0	0	0	0
34	75	8	4	25	8	0	0	4	0	4	1	0.5
35	75	9	6	50	10	0	0	9	0	9	1.5	0.9
36	75	10	2	100	2	0	0	4	0	4	2	2
37	75	11	7	29	16	3	3	0	100	6	.86	.38
38	75	12	5	20	6	0	1	0	0	1	0.2	.17
39	76	1	3	33	4	0	0	1	0	1	.33	.25
40	76	2	5	40	6	0	0	5	0	5	1	.83
41	76	3	4	75	7	0	0	8	0	8	2	1.1
42	76	4	10	50	39	0	0	19	0	19	1.9	.49
43	76	5	7	57	13	0	0	6	0	6	.86	.46
44	76	6	5	40	6	0	0	3	0	3	0.6	0.5
45	76	7	9	89	19	0	0	23	0	23	2.6	1.2
46	76	8	5	100	9	0	0	18	0	18	3.6	2
47	76	9	6	83	10	6	2	0	300	8	1.3	0.8
48	76	10	7	57	11	4	3	0	0	7	1	.64
49	76	11	5	60	8	4	1	2	400	7	1.4	.88
50	76	12	5	60	10	4	5	6	80	15	3	1.5
51	77	1	3	67	7	3	2	3	150	8	2.7	1.1
52	77	2	7	100	13	0	0	22	0	22	3.1	1.7
53	77	3	8	75	26	18	17	0	0	35	4.4	1.3
54	77	4	11	[illegible]	[illegible]	14	20	0	70	34	3.1	1.4

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SES	TOT	KIL	KIL
57	77	7	13	92	34	0	0	46	0	46	3.5	1.4
58	77	8	8	100	24	0	0	39	0	39	4.9	1.6
59	77	9	7	100	14	0	0	31	0	31	4.4	2.2
60	77	10	8	88	20	16	7	0	0	23	2.9	1.2
61	77	11	7	71	15	6	8	0	75	14	2	.93
62	77	12	11	100	31	18	12	0	150	30	2.7	.97
63	78	1	9	100	30	17	13	0	0	30	3.3	1
64	78	2	10	90	27	18	18	0	100	36	3.6	1.3
65	78	3	9	78	17	11	16	12	69	39	4.3	2.3
66	78	4	11	73	20	18	16	0	0	34	3.1	1.7
67	78	5	8	75	18	7	16	0	44	23	2.9	1.3
68	78	6	4	100	15	22	21	0	0	43	11	2.9
69	78	7	9	78	14	14	27	0	52	41	4.6	2.9
70	78	8	5	100	11	10	17	0	59	27	5.4	2.5
71	78	9	6	100	8	9	14	0	64	23	3.8	2.9
72	78	10	7	48	15	3	4	0	75	7	1	.47
73	78	11	5	80	9	5	12	0	42	17	3.4	1.9
74	78	12	8	88	12	8	4	0	200	12	1.5	1
75	79	1	2	100	5	6	11	0	55	17	8.5	3.4
76	79	2	4	100	5	5	5	0	100	10	2.5	2
77	79	3	6	83	12	6	6	0	100	12	2	1
78	79	4	3	100	3	4	4	0	100	8	2.7	2.7
79	79	5	6	67	15	6	10	0	60	16	2.7	1.1
80	79	6	4	100	12	8	8	0	100	16	4	1.3
81	79	7	11	73	28	7	12	0	58	19	1.7	.68
82	79	8	5	20	9	1	0	0	0	1	0.2	.11
83	79	9	10	80	24	8	6	1	0	15	1.5	.63
84	79	10	6	67	11	3	4	0	75	7	1.2	.64
85	79	11	5	60	9	0	5	3	0	8	1.6	.89
86	79	12	9	78	19	5	7	2	71	14	1.6	.74
87	80	1	6	17	17	1	1	2	100	4	.67	.24
88	80	2	5	40	16	1	1	0	100	2	0.4	.13
89	80	3	1	0	2	0	0	0	0	0	0	0
90	80	4	7	57	12	2	5	10	40	17	2.4	1.4
91	80	5	7	71	15	2	2	5	100	9	1.3	0.6
92	80	6	3	100	5	1	4	0	25	5	1.7	1
93	80	7	4	100	5	1	1	13	100	15	3.8	3
94	80	8	4	100	9	0	0	9	0	9	2.3	1
95	80	9	4	75	7	2	4	4	50	10	2.5	1.4
96	80	10	6	83	9	1	3	8	33	12	2	1.3
97	80	11	5	40	10	0	0	3	0	3	0.6	0.3
98	80	12	1	100	2	0	0	1	0	1	1	0.5
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	5	20	11	0	0	1	0	1	0.2	.09
101	81	3	6	67	8	0	0	6	0	6	1	.75

102	81	4	1	0	2	0	0	0	0	0	0	0
103	81	5	2	0	4	0	0	0	0	0	0	0
104	81	6	1	100	2	3	0	0	0	3	3	1.5
105	81	7	6	67	15	4	9	0	44	13	2.2	.87
106	81	8	3	33	6	2	0	0	0	2	.67	.33
107	81	9	3	0	4	0	0	0	0	0	0	0
108	81	10	1	0	1	0	0	0	0	0	0	0
109	81	11	1	0	4	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	3	100	8	5	2	0	250	7	2.3	.88
112	82	2	10	80	35	5	6	4	83	15	1.5	.43

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SES	TOT	KIL	KIL
113	82	3	8	63	35	2	2	7	100	11	1.4	.31
114	82	4	8	100	22	—12	2	0	600	14	1.8	.64
115	82	5	4	50	13	2	2	4	100	8	2	.62
116	82	6	10	20	32	5	3	0	0	8	0.8	.25
117	82	7	1	0	1	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	1	0	1	0	0	0	0	0	0	0
120	82	10	1	0	1	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	12	8	15	1	0	0	0	1	.08	.07
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	4	25	14	0	0	1	0	1	.25	.07
2	72	12	3	0	10	0	0	0	0	0	0	0
3	73	1	2	0	9	0	0	0	0	0	0	0
4	73	2	1	0	2	0	0	0	0	0	0	0
5	73	3	3	0	6	0	0	0	0	0	0	0
6	73	4	1	0	1	0	0	0	0	0	0	0
7	73	5	0	0	0	0	0	0	0	0	0	0
8	73	6	0	0	0	0	0	0	0	0	0	0
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	0	0	0	0	0	0	0	0	0	0
11	73	9	0	0	0	0	0	0	0	0	0	0
12	73	10	0	0	0	0	0	0	0	0	0	0
13	73	11	0	0	0	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	1	0	1	0	0	0	0	0	0	0
16	74	2	0	0	0	0	0	0	0	0	0	0
17	74	3	0	0	0	0	0	0	0	0	0	0
18	74	4	0	0	0	0	0	0	0	0	0	0
19	74	5	1	0	2	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	1	100	5	1	0	0	0	1	1	0.2
22	74	8	1	0	1	0	0	0	0	0	0	0
23	74	9	3	33	6	0	0	1	0	1	.33	.17
24	74	10	2	0	7	0	0	0	0	0	0	0
25	74	11	0	0	0	0	0	0	0	0	0	0
26	74	12	1	0	1	0	0	0	0	0	0	0
27	75	1	2	50	3	0	0	2	0	2	1	.67
28	75	2	2	0	6	0	0	0	0	0	0	0
29	75	3	4	0	7	0	0	0	0	0	0	0
30	75	4	2	0	6	0	0	0	0	0	0	0
31	75	5	3	0	7	0	0	0	0	0	0	0
32	75	6	1	0	2	0	0	0	0	0	0	0
33	75	7	0	0	0	0	0	0	0	0	0	0
34	75	8	0	0	0	0	0	0	0	0	0	0
35	75	9	0	0	0	0	0	0	0	0	0	0
36	75	10	1	0	2	0	0	0	0	0	0	0
37	75	11	0	0	0	0	0	0	0	0	0	0
38	75	12	0	0	0	0	0	0	0	0	0	0
39	76	1	2	0	5	0	0	0	0	0	0	0
40	76	2	2	0	2	0	0	0	0	0	0	0
41	76	3	0	0	0	0	0	0	0	0	0	0
42	76	4	4	0	5	0	0	0	0	0	0	0
43	76	5	1	0	1	0	0	0	0	0	0	0
44	76	6	0	0	0	0	0	0	0	0	0	0
45	76	7	2	50	2	1	0	0	0	1	0.5	0.5
46	76	8	0	0	0	0	0	0	0	0	0	0
47	76	9	5	0	12	0	0	0	0	0	0	0
48	76	10	1	0	2	0	0	0	0	0	0	0
49	76	11	0	0	0	0	0	0	0	0	0	0
50	76	12	4	25	5	0	0	1	0	1	.25	0.2
51	77	1	3	67	5	2	0	0	0	2	.67	0.4
52	77	2	0	0	0	0	0	0	0	0	0	0
53	77	3	4	0	4	0	0	0	0	0	0	0
54	77	4	7	0	18	0	0	0	0	0	0	0
55	77	5	4	25	7	1	0	0	0	1	.25	.14
56	77	6	1	0	1	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	10	10	22	1	0	0	0	1	0.1	.05
82	79	8	4	0	10	0	0	0	0	0	0	0
83	79	9	2	0	2	0	0	0	0	0	0	0
84	79	10	1	0	1	0	0	0	0	0	0	0
85	79	11	1	0	3	0	0	0	0	0	0	0
86	79	12	3	0	5	0	0	0	0	0	0	0
87	80	1	1	0	4	0	0	0	0	0	0	0
88	80	2	1	0	3	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	2	50	4	0	0	2	0	2	1	0.5
92	80	6	2	50	3	1	0	0	0	1	0.5	.33
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	1	0	1	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	1	100	3	1	1	0	100	2	2	.67
99	81	1	1	100	1	0	0	1	0	1	1	1
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	0	0	0	0	0	0	0	0	0	0
102	81	4	1	0	2	0	0	0	0	0	0	0
103	81	5	7	86	12	2	3	14	67			
										19	2.7	1.6
104	81	6	3	67	4	7	1	3	700	11	3.7	2.8
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	1	100	2	1	1	0	100	2	2	1
109	81	11	2	100	4	2	0	0	0	2	1	0.5
110	81	12	1	100	2	0	1	0	0	1	1	0.5
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	1	100	2	1	2	0	50	3	3	1.5
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	0	0	0	0	0	0	0	0	0	0
116	82	6	1	0	2	0	0	0	0	0	0	0
117	82	7	1	0	3	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	0	0	0	0	0	0	0	0	0	0
121	82	11	2	50	5	0	1	0	0	1	0.5	0.2
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	4	0	4	0	0	0	0	0	0	0
2	72	12	2	50	6	0	0	1	0	1	0.5	.17
3	73	1	2	0	6	0	0	0	0	0	0	0
4	73	2	2	0	5	0	0	0	0	0	0	0
5	73	3	1	0	2	0	0	0	0	0	0	0
6	73	4	3	0	8	0	0	0	0	0	0	0
7	73	5	0	0	0	0	0	0	0	0	0	0
8	73	6	0	0	0	0	0	0	0	0	0	0
9	73	7	2	0	2	0	0	0	0	0	0	0
10	73	8	2	0	3	0	0	0	0	0	0	0
11	73	9	0	0	0	0	0	0	0	0	0	0
12	73	10	1	0	3	0	0	0	0	0	0	0
13	73	11	1	0	2	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	1	0	2	0	0	0	0	0	0	0
17	74	3	1	0	4	0	0	0	0	0	0	0
18	74	4	2	0	2	0	0	0	0	0	0	0
19	74	5	1	0	2	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	1	0	3	0	0	0	0	0	0	0
22	74	8	1	0	2	0	0	0	0	0	0	0
23	74	9	1	0	1	0	0	0	0	0	0	0
24	74	10	0	0	0	0	0	0	0	0	0	0
25	74	11	3	0	8	0	0	0	0	0	0	0
26	74	12	3	0	8	0	0	0	0	0	0	0
27	75	1	1	0	2	0	0	0	0	0	0	0
28	75	2	0	0	0	0	0	0	0	0	0	0
29	75	3	3	0	5	0	0	0	0	0	0	0
30	75	4	5	0	19	0	0	0	0	0	0	0
31	75	5	4	0	15	0	0	0	0	0	0	0
32	75	6	0	0	0	0	0	0	0	0	0	0
33	75	7	1	0	1	0	0	0	0	0	0	0
34	75	8	3	0	5	0	0	0	0	0	0	0
35	75	9	1	0	1	0	0	0	0	0	0	0
36	75	10	1	0	1	0	0	0	0	0	0	0
37	75	11	4	25	5	0	0	1	0	1	.25	0.2
38	75	12	1	0	4	0	0	0	0	0	0	0
39	76	1	2	0	3	0	0	0	0	0	0	0
40	76	2	2	0	2	0	0	0	0	0	0	0
41	76	3	1	0	2	0	0	0	0	0	0	0
42	76	4	2	0	4	0	0	0	0	0	0	0
43	76	5	2	0	2	0	0	0	0	0	0	0
44	76	6	1	0	1	0	0	0	0	0	0	0
45	76	7	0	0	0	0	0	0	0	0	0	0
46	76	8	3	0	4	0	0	0	0	0	0	0
47	76	9	3	0	7	0	0	0	0	0	0	0
48	76	10	6	0	11	0	0	0	0	0	0	0
49	76	11	2	0	7	0	0	0	0	0	0	0
50	76	12	2	0	3	0	0	0	0	0	0	0
51	77	1	2	0	11	0	0	0	0	0	0	0
52	77	2	2	0	3	0	0	0	0	0	0	0
53	77	3	3	0	8	0	0	0	0	0	0	0
54	77	4	2	0	11	0	0	0	0	0	0	0
55	77	5	0	0	0	0	0	0	0	0	0	0
56	77	6	1	0	2	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	2	0	2	0	0	0	0	0	0	0
82	79	8	4	0	9	0	0	0	0	0	0	0
83	79	9	0	0	0	0	0	0	0	0	0	0
84	79	10	0	0	0	0	0	0	0	0	0	0
85	79	11	0	0	0	0	0	0	0	0	0	0
86	79	12	1	0	2	0	0	0	0	0	0	0
87	80	1	1	0	2	0	0	0	0	0	0	0
88	80	2	2	0	2	0	0	0	0	0	0	0
89	80	3	1	0	3	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	0	0	0	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	2	0	4	0	0	0	0	0	0	0
102	81	4	1	0	2	0	0	0	0	0	0	0
103	81	5	1	100	2	1	0	0	0	1	1	0.5
104	81	6	1	0	1	0	0	0	0	0	0	0
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	0	0	0	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	0	0	0	0	0	0	0	0	0	0
116	82	6	0	0	0	0	0	0	0	0	0	0
117	82	7	0	0	0	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	0	0	0	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	1	0	1	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	0	0	0	0	0	0	0	0	0	0
2	72	12	0	0	0	0	0	0	0	0	0	0
3	73	1	0	0	0	0	0	0	0	0	0	0
4	73	2	0	0	0	0	0	0	0	0	0	0
5	73	3	0	0	0	0	0	0	0	0	0	0
6	73	4	0	0	0	0	0	0	0	0	0	0
7	73	5	0	0	0	0	0	0	0	0	0	0
8	73	6	0	0	0	0	0	0	0	0	0	0
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	0	0	0	0	0	0	0	0	0	0
11	73	9	0	0	0	0	0	0	0	0	0	0
12	73	10	0	0	0	0	0	0	0	0	0	0
13	73	11	0	0	0	0	0	0	0	0	0	0
14	73	12	0	0	0	0	0	0	0	0	0	0
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	0	0	0	0	0	0	0	0	0	0
17	74	3	0	0	0	0	0	0	0	0	0	0
18	74	4	0	0	0	0	0	0	0	0	0	0
19	74	5	0	0	0	0	0	0	0	0	0	0
20	74	6	0	0	0	0	0	0	0	0	0	0
21	74	7	0	0	0	0	0	0	0	0	0	0
22	74	8	0	0	0	0	0	0	0	0	0	0
23	74	9	0	0	0	0	0	0	0	0	0	0
24	74	10	0	0	0	0	0	0	0	0	0	0
25	74	11	0	0	0	0	0	0	0	0	0	0
26	74	12	0	0	0	0	0	0	0	0	0	0
27	75	1	0	0	0	0	0	0	0	0	0	0
28	75	2	0	0	0	0	0	0	0	0	0	0
29	75	3	0	0	0	0	0	0	0	0	0	0
30	75	4	0	0	0	0	0	0	0	0	0	0
31	75	5	0	0	0	0	0	0	0	0	0	0
32	75	6	0	0	0	0	0	0	0	0	0	0
33	75	7	0	0	0	0	0	0	0	0	0	0
34	75	8	0	0	0	0	0	0	0	0	0	0
35	75	9	0	0	0	0	0	0	0	0	0	0
36	75	10	0	0	0	0	0	0	0	0	0	0
37	75	11	0	0	0	0	0	0	0	0	0	0
38	75	12	0	0	0	0	0	0	0	0	0	0
39	76	1	0	0	0	0	0	0	0	0	0	0
40	76	2	0	0	0	0	0	0	0	0	0	0
41	76	3	0	0	0	0	0	0	0	0	0	0
42	76	4	0	0	0	0	0	0	0	0	0	0
43	76	5	0	0	0	0	0	0	0	0	0	0
44	76	6	0	0	0	0	0	0	0	0	0	0
45	76	7	0	0	0	0	0	0	0	0	0	0
46	76	8	0	0	0	0	0	0	0	0	0	0
47	76	9	0	0	0	0	0	0	0	0	0	0
48	76	10	0	0	0	0	0	0	0	0	0	0
49	76	11	0	0	0	0	0	0	0	0	0	0
50	76	12	0	0	0	0	0	0	0	0	0	0
51	77	1	0	0	0	0	0	0	0	0	0	0
52	77	2	0	0	0	0	0	0	0	0	0	0
53	77	3	0	0	0	0	0	0	0	0	0	0
54	77	4	0	0	0	0	0	0	0	0	0	0
55	77	5	0	0	0	0	0	0	0	0	0	0
56	77	6	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	0	0	0	0	0	0	0	0	0	0
82	79	8	0	0	0	0	0	0	0	0	0	0
83	79	9	0	0	0	0	0	0	0	0	0	0
84	79	10	0	0	0	0	0	0	0	0	0	0
85	79	11	0	0	0	0	0	0	0	0	0	0
86	79	12	0	0	0	0	0	0	0	0	0	0
87	80	1	0	0	0	0	0	0	0	0	0	0
88	80	2	0	0	0	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	0	0	0	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	0	0	0	0	0	0	0	0	0	0
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	0	0	0	0	0	0	0	0	0	0
104	81	6	0	0	0	0	0	0	0	0	0	0
105	81	7	1	0	3	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	0	0	0	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	1	0	1	0	0	0	0	0	0	0
116	82	6	0	0	0	0	0	0	0	0	0	0
117	82	7	0	0	0	0	0	0	0	0	0	0
118	82	8	1	0	2	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	1	0	2	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	2	0	2	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
1	72	11	4	50	11	1	1	5	100	7	1.8	.64
2	72	12	7	43	25	1	0	3	0	4	.57	.16
3	73	1	5	0	8	0	0	0	0	0	0	0
4	73	2	2	0	3	0	0	0	0	0	0	0
5	73	3	3	33	6	0	0	1	0	1	.33	.17
6	73	4	3	33	5	0	1	0	0	1	.33	0.2
7	73	5	2	50	4	1	0	0	0	1	0.5	.25
8	73	6	2	0	2	0	0	0	0	0	0	0
9	73	7	0	0	0	0	0	0	0	0	0	0
10	73	8	0	0	0	0	0	0	0	0	0	0
11	73	9	2	50	4	0	0	2	0	2	1	0.5
12	73	10	0	0	0	0	0	0	0	0	0	0
13	73	11	2	50	5	0	0	1	0	1	0.5	0.2
14	73	12	2	50	4	2	0	0	0	2	1	0.5
15	74	1	0	0	0	0	0	0	0	0	0	0
16	74	2	4	25	6	0	1	0	0	1	.25	.17
17	74	3	5	20	10	0	0	2	0	2	0.4	0.2
18	74	4	3	33	4	1	1	0	100	2	.67	0.5
19	74	5	1	0	2	0	0	0	0	0	0	0
20	74	6	3	0	4	0	0	0	0	0	0	0
21	74	7	2	50	4	0	0	1	0	1	0.5	.25
22	74	8	3	0	4	0	0	0	0	0	0	0
23	74	9	2	0	3	0	0	0	0	0	0	0
24	74	10	5	20	7	0	0	1	0	1	0.2	.14
25	74	11	4	50	4	1	0	1	0	2	0.5	0.5
26	74	12	6	17	11	0	1	0	0	1	.17	.09
27	75	1	4	0	5	0	0	0	0	0	0	0
28	75	2	0	0	0	0	0	0	0	0	0	0
29	75	3	1	0	3	0	0	0	0	0	0	0
30	75	4	3	33	5	1	0	0	0	1	.33	0.2
31	75	5	1	100	2	0	1	0	0	1	1	0.5
32	75	6	6	0	7	0	0	0	0	0	0	0
33	75	7	3	0	3	0	0	0	0	0	0	0
34	75	8	3	0	5	0	0	0	0	0	0	0
35	75	9	5	20	8	1	0	0	0	1	0.2	.13
36	75	10	4	0	4	0	0	0	0	0	0	0
37	75	11	1	0	1	0	0	0	0	0	0	0
38	75	12	4	0	10	0	0	0	0	0	0	0
39	76	1	4	0	9	0	0	0	0	0	0	0
40	76	2	5	0	7	0	0	0	0	0	0	0
41	76	3	2	0	4	0	0	0	0	0	0	0
42	76	4	4	0	6	0	0	0	0	0	0	0
43	76	5	2	0	3	0	0	0	0	0	0	0
44	76	6	3	0	3	0	0	0	0	0	0	0
45	76	7	1	0	1	0	0	0	0	0	0	0
46	76	8	2	0	2	0	0	0	0	0	0	0
47	76	9	2	0	2	0	0	0	0	0	0	0
48	76	10	2	0	3	0	0	0	0	0	0	0
49	76	11	5	40	6	1	2	0	50	3	0.6	0.5
50	76	12	0	0	0	0	0	0	0	0	0	0
51	77	1	0	0	0	0	0	0	0	0	0	0
52	77	2	2	0	5	0	0	0	0	0	0	0
53	77	3	1	0	2	0	0	0	0	0	0	0
54	77	4	3	33	4	0	2	0	0	2	.67	0.5
55	77	5	1	0	1	0	0	0	0	0	0	0
56	77	6	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
57	77	7	0	0	0	0	0	0	0	0	0	0
58	77	8	0	0	0	0	0	0	0	0	0	0
59	77	9	0	0	0	0	0	0	0	0	0	0
60	77	10	0	0	0	0	0	0	0	0	0	0
61	77	11	0	0	0	0	0	0	0	0	0	0
62	77	12	0	0	0	0	0	0	0	0	0	0
63	78	1	0	0	0	0	0	0	0	0	0	0
64	78	2	0	0	0	0	0	0	0	0	0	0
65	78	3	0	0	0	0	0	0	0	0	0	0
66	78	4	0	0	0	0	0	0	0	0	0	0
67	78	5	0	0	0	0	0	0	0	0	0	0
68	78	6	0	0	0	0	0	0	0	0	0	0
69	78	7	0	0	0	0	0	0	0	0	0	0
70	78	8	0	0	0	0	0	0	0	0	0	0
71	78	9	0	0	0	0	0	0	0	0	0	0
72	78	10	0	0	0	0	0	0	0	0	0	0
73	78	11	0	0	0	0	0	0	0	0	0	0
74	78	12	0	0	0	0	0	0	0	0	0	0
75	79	1	0	0	0	0	0	0	0	0	0	0
76	79	2	0	0	0	0	0	0	0	0	0	0
77	79	3	0	0	0	0	0	0	0	0	0	0
78	79	4	0	0	0	0	0	0	0	0	0	0
79	79	5	0	0	0	0	0	0	0	0	0	0
80	79	6	0	0	0	0	0	0	0	0	0	0
81	79	7	2	0	2	0	0	0	0	0	0	0
82	79	8	1	0	1	0	0	0	0	0	0	0
83	79	9	2	0	2	0	0	0	0	0	0	0
84	79	10	1	0	1	0	0	0	0	0	0	0
85	79	11	1	0	1	0	0	0	0	0	0	0
86	79	12	1	100	2	0	1	0	0	1	1	0.5
87	80	1	2	50	4	0	0	1	0	1	0.5	.25
88	80	2	2	0	3	0	0	0	0	0	0	0
89	80	3	0	0	0	0	0	0	0	0	0	0
90	80	4	0	0	0	0	0	0	0	0	0	0
91	80	5	0	0	0	0	0	0	0	0	0	0
92	80	6	0	0	0	0	0	0	0	0	0	0
93	80	7	0	0	0	0	0	0	0	0	0	0
94	80	8	0	0	0	0	0	0	0	0	0	0
95	80	9	0	0	0	0	0	0	0	0	0	0
96	80	10	0	0	0	0	0	0	0	0	0	0
97	80	11	0	0	0	0	0	0	0	0	0	0
98	80	12	0	0	0	0	0	0	0	0	0	0
99	81	1	0	0	0	0	0	0	0	0	0	0
100	81	2	0	0	0	0	0	0	0	0	0	0
101	81	3	0	0	0	0	0	0	0	0	0	0
102	81	4	0	0	0	0	0	0	0	0	0	0
103	81	5	0	0	0	0	0	0	0	0	0	0
104	81	6	0	0	0	0	0	0	0	0	0	0
105	81	7	0	0	0	0	0	0	0	0	0	0
106	81	8	0	0	0	0	0	0	0	0	0	0
107	81	9	0	0	0	0	0	0	0	0	0	0
108	81	10	0	0	0	0	0	0	0	0	0	0
109	81	11	0	0	0	0	0	0	0	0	0	0
110	81	12	0	0	0	0	0	0	0	0	0	0
111	82	1	0	0	0	0	0	0	0	0	0	0
112	82	2	0	0	0	0	0	0	0	0	0	0

REC#	YR	MO	GR	%SU	HUN	BOA	SOW	UNK	SEX	TOTK	KIL	KIL
113	82	3	0	0	0	0	0	0	0	0	0	0
114	82	4	0	0	0	0	0	0	0	0	0	0
115	82	5	0	0	0	0	0	0	0	0	0	0
116	82	6	0	0	0	0	0	0	0	0	0	0
117	82	7	0	0	0	0	0	0	0	0	0	0
118	82	8	0	0	0	0	0	0	0	0	0	0
119	82	9	0	0	0	0	0	0	0	0	0	0
120	82	10	0	0	0	0	0	0	0	0	0	0
121	82	11	0	0	0	0	0	0	0	0	0	0
122	82	12	0	0	0	0	0	0	0	0	0	0
123	83	1	0	0	0	0	0	0	0	0	0	0
124	83	2	0	0	0	0	0	0	0	0	0	0

MODELING POPULATIONS WITH EXISTING MICROCOMPUTER SOFTWARE

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The purpose of this paper is to advertise the ease of using business oriented financial planning software on microcomputers for modeling the dynamics of wildlife populations. Conceivably even field personnel in remote locations could purchase, set up and run this equipment without more assistance than that available in the manuals provided at the time of purchase. Knowledge of population dynamics would be required of course.

Wildlife biologists have been interested in modeling wildlife population dynamics for many years, but most efforts have required the development of specialized programs for use on main frame or minicomputers. While those with access to these larger computers have found population modeling useful in managing certain species of ungulates (Walters and Gross 1972, Conley 1978), carnivores (Bunnell and Tait 1978), small mammals (Conley and Nichols 1978), waterfowl (Cowardin and Johnson 1979), upland game (Lobdell et al. 1972), raptors (Grier 1980), songbirds (Pennycuick 1969) and reptiles (Nichols et al. 1976), the majority of field biologists are stationed too far away from such machines to use them regularly. Moreover, most field biologists do not have the programming skills to use the larger computers effectively.

After having spent a considerable amount of time attempting to adapt existing programs to large and small computers, and even attempting to write my own programs, I discovered I could construct "templates" for a "spreadsheet" program to model a wide range of wildlife species from elk (*Elaphus canadensis*) to nene (*Branta sandvicensis*) with relative ease. Moreover, by obtaining a graphics program that would interact easily with the spreadsheet program I could readily graph my results for more effective communication to others. Therefore, despite easy access to a large computer, I have found that the portability, low running cost and undisturbed access to the "user friendly", personal computer software have more than offset the capital outlay for the system.

THE GENERAL APPROACH

While I used VISICALC (Wolverton 1981, Williams and Taylor 1981, Castlewitz et al. 1982) and VISIPLOT (Ewing 1982) on an IBM Personal Computer (Goldstein and Goldstein 1982) with 128K random access memory (RAM), the same approach could be used on any of a variety of similar spreadsheet programs available for a host of different microcomputers with as little as 64K RAM. Several newer programs encorporate the modeling and graphics capabilities into just one program, making the process even simpler than described here.

All spreadsheet programs are designed to mimic a large ledger comprised of a matrix of "cells" into which can be entered lables or values. Values can be entered directly as raw data, such as the number of individuals in an age class, or as the result of functions. Functions are important in modeling as once an initial population structure, a carrying capacity and a harvest regime are entered, all following values are computed on the basis of functions built into the template. This template, or matrix of functions, comprises the basic model and can be stored for future use on magnetic tape or disk so the numerous functions typically involved do not need to be reentered manually at each modeling session. A different model (template) would be constructed for each species and even for different populations of the same species from different environments.

Constructing A Spreadsheet Template

First the problem must be defined (Tipton 1977, 1980:214). A typical question is how will a specified harvest scheme affect a population? The procedure then consists of two major exercises. First, a template is constructed without reference to particular carrying capacity, harvest or sex-age structure values; only sex and age specific natality, and survivorship data (assuming zero dispersal) are required at this stage. The first step is to determine the time interval for the model as each period will require one row across the spreadsheet. A year or 6-month interval will be appropriate for long-lived species, but those living only 2 years, for example, should be modeled with 4-month to 1-month intervals. The time interval automatically determines the number of age classes that must be considered, thus there is a tradeoff between the detail of the model and the total number of periods that can be included in one run for a given amount of RAM. It is possible, but inconvenient, to "recycle" a run by moving the last line of the spreadsheet to the first line by means of a data interchange format (DIF) file (Kalish and Mayer 1981). With VISICALC this takes 2 to 3 minutes. If a great amount of modeling is expected it would be advisable to purchase more RAM, allowing a bigger spreadsheet.

If a density dependent model is desired, age specific natality and survivorship data must be available, or estimated, for the population at carrying capacity (CC), and also when it is very low relative to CC. I use CC here to mean "ecological carrying capacity" (Caughley 1977), or "equilibrium density" (Fowler and Smith 1973, Savidge and Ziesenis 1980:406).

Although nonlinear relationships between age specific natality or survivorship and density can be modeled, I suggest that simple, linear functions be used unless emperical data suggest otherwise. If a variety of age specific functions with differing slopes are used the resulting relationship for the population as a whole may be curvilinear. For example, to formulate a function for the survivorship of yearlings relative to density of the entire population it is determined that survivorship is about 70 percent when the density is very low and about 30 percent when at CC. By using the ratio of population size to CC as the independent variable, a simple linear regression can be derived with a suitable hand calculator. In this case the two pairs of data (0,.7 and 1,.3) yield the function:

Survivors = Yearlings x (0.7 - 0.4 x Pop/CC),

where -0.4 is the slope of the regression. One can calculate that in this case no yearlings would survive if the adult population reached 1.75 times CC.

Similarly, if it was known that yearling females produce an average of two young per year under optimum conditions but none when the adult population is at CC the two pairs of data (0,2 and 1,0) could be used to construct the following function:

Births from yearlings = Yearling females x (2 - 2 x Pop/CC).

Using the same procedure to derive the production from all age classes, the total number of births for a given time interval is obtained by summation. Greater knowledge (or an active imagination) may allow more complex functions to be constructed; however, those illustrated here are the simplest to start with, being analogous to the logistic model (Savidge and Ziesinis 1980).

Constants for each run may be entered at the top of the spreadsheet in cells within a heading composed primarily of lables, such as a title or brief instructions for running or printing the model. For example, CC (if constant throughout a run) and harvest (absolute or percentage) could be entered here to minimize the need for additional columns in the model itself. At least one summary statistic, total population, must be located in a column to the right side of the spreadsheet as this is the output that one would normally wish to monitor. It is also more efficient to similarly list any summary statistics that will be used as variables in functions over time, e.g. the ratio of population size to CC.

When natality and survivorship functions have been developed for all age classes expected they are entered into the spreadsheet and the model is run for a constant CC (say 1000) with no harvest. If all the functions within the model are internally consistent the adult population should stabilize in due time at the designated CC regardless of the starting population structure. Rarely will this be the case, however. Normally the model must be "fine tuned" by repeated, judicious adjustments of the natality and survivorship rates. Since reproductive information is generally more readily available, I suggest that most adjustments be made in the survivorship functions. It will become evident that a change in the survivorship functions for younger age classes will have a much greater effect than similar changes for older age classes. Therefore the final, very small adjustments are most easily made in these older age classes.

Especially for prolific, short-lived species for which the time interval in the model is a whole year, the initial run may produce a cyclic population pattern. If the available data for natality and survivorship are suspect, and the species is known not to be cyclic, then the regression intercepts or the slopes should be lowered until the population stabilizes. To adjust the stable point upwards increase the intercepts and vise versa. The details of which age classes should be adjusted, and within what limits, must be left up to the best judgement of those most familiar with the population concerned. When the model stabilizes the adult population at the designated CC the first major part of the modeling process is complete, and the template should be stored on two or more tapes or disks for safekeeping.

Running The Model

The second major exercise involves repeated runs of the basic model with varying combinations of values for 1) carrying capacity, 2) initial population sex and age structure, and 3) harvest regime. The output for each run appears as a matrix of values for the number of individuals in each sex-age class for each time interval, plus any additional summary statistics desired or required to drive density dependent functions. Total population, percent harvest, births per 100 females and sex ratios would be typical summary statistics. The only limits to such data are one's imagination and the amount of RAM available beyond that used for the basic population structure matrix.

Each column of the spreadsheet represents the values for a particular statistic over time and can be saved in a DIF file for storage or transfer to a graphics program such as VISIPLOT. This particular software package generates line or bar graphs, including multiple lines or even combinations of lines and bars on one graph to represent, for example, the change in adult population (line) relative to a periodic harvest (bars) over time. By combining DIF files for the same statistic one can produce a graph of several model runs, thus extending the total time involved to over 200 periods.

As outlined so far, a spreadsheet population dynamics model could be described as a relatively complex, thus realistic simulation model using difference equations to provide deterministic predictions for applied biologists (Tipton 1980). Limitations of such models include: 1) not being able to readily calculate optimum solutions to problems, as is possible with analytical models; 2) difficulty mimicing continuously breeding populations without using inordinately short time intervals; 3) difficulty in obtaining accurate estimates of the many necessary parameters; and 4) the lack of consideration for stochastic effects.

The last item can be delt with to some extent. By rounding all results to integers one can at least deal in whole animals. Nevertheless, the models work best for populations over 100 animals. Variations in carrying capacity can be modeled by manually entering randomized values based on frequency distributions for weather patterns or food production. Harvest schedules can be similarly randomized before entering. VISICALC does not encorporate a random number generator, but other spreadsheet software may. If so, repeated runs could be made more readily to determine means and variences for output variables of interest.

AN EXAMPLE

The following example is explained in some detail to illustrate one way of constructing a population dynamics model for simulating the effects of various harvesting schemes on a feral pig (*Sus scrofa*) population in northern California (Barrett 1978). The values used are based on over 10 years of observations in California, the details to be published elsewhere, plus additional observations in Australia and Hawaii. My intent here is not to justify the accuracy of this particular model, but to use it as an example of the kind of work that can be accomplished with commercially available spreadsheet software for a microcomputer.

The pig model utilizes a 45- by 45-cell spreadsheet requiring 128K of RAM. The default column width of 9 spaces per cell is used, but all functions are computed to 12 places and rounded to the nearest integer. Calculations proceed from left to right across rows, starting at the top left and finishing at the bottom right of the matrix. One run through the 2025 cells requires 45 seconds. The layout consists of 2 sets of population structure data (for boars and for sows) based on a 6-month time interval (13 age classes plus totals by 40 seasons or 20 years, plus 4 rows for labels at the top), and one set of 15 summary statistics. This layout was designed to be printed by an Epson MX80 printer using "compressed type" (Lien 1982) with the 3 sections placed one after the other on 2 standard, letter-sized sheets of paper (Figure 1).

With the necessary biological data in hand it took me a day to construct and fine-tune the basic model. The details of the functions and summary statistics are listed for the first 6 rows of the spreadsheet in the Appendix. The fine-tuning was accomplished by varying the survivorship functions as described above. When attempting to enter such large numbers of functions into VISICALC one should switch the recalculation command to manual start mode and work from left to right down the rows. Once row 6 (the second time interval) has been entered, all remaining rows can be filled in a few minutes with the VISICALC replicate command. With more RAM the number of rows, hence years in a run, can be increased accordingly. Each row of the pig model requires about 2K RAM.

The model assumes that both sexes have identical survivorship functions and that the primary sex ratio is even. It also assumes that animals over 6 months of age are adults, that only adults are harvested, that they are harvested non-selectively for age, and that only the adult population is important in determining the degree of intraspecific competition. Moreover, it is assumed that the population is food-limited, that natural predators are unimportant, and that both natality and survivorship are linear functions of the ratio of the adult population to seasonal CC.

Sows produce their first litter when about a year old and continue to farrow about twice a year thereafter (Barrett 1978). Thus, birth rates represent the average number of young produced per sow for each 6-month season (fertility and fecundity are not distinguished), modified by the pre-harvest population to CC ratio. Survivorship is a function of the adult population remaining after harvest relative to the seasonal CC. Hence, hunting mortality is assumed to be compensatory with natural mortality. The density dependence of piglet survival is assumed to be considerably greater than that of adult survival; in fact, this is the primary regulatory mechanism in the model. There is nothing sacred about the assumptions used; the model could easily be modified to encompase different assumptions.

Once established, the basic model was run to determine the stable age distribution at CC and for a range of harvest rates (1 to 58.5%). Over 100 years were required for stabilization with the higher harvest rates. A summary of these results is presented in Figure 2. Of greater practical value would be analyses of harvests selective for older boars or other classes, or of known harvest schedules if the data were available.

I also ran the model after entering seasonal CC's randomized separately for fall-winter (to mimic variation in acorn availability) and spring-summer (to mimic variation in the effect of spring rainfall on the availability of green herbs). The impact of these stochastic patterns along with no harvests, and with the sex-specific harvests recorded for the Dye Creek Preserve is illustrated in Figure 3.

SUMMARY AND CONCLUSIONS

The example above illustrates the considerable power now potentially available to any field biologist willing to make a modest investment of time in learning to use easily obtainable software for microcomputers. I invested approximately 20 hours in learning to use the basic spreadsheet program. Population modeling is only one use of this equipment. However, population modeling alone would justify the use of these tools by a biologist charged with managing important wildlife populations.

A competent programmer could write similar, but more efficient modeling programs for specific cases (possibly based on spreadsheet prototypes). Unfortunately few such programs are presently available to the average field biologist. An important aspect of building one's own models on site with easy-to-use software is that field biologists are more likely to enjoy the satisfaction of using their own creativity and intimate knowledge of local populations to build models tailored to their specific needs. They are also likely to develop a better understanding of the dynamics of the resources they must manage in the process.

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Figure Headings

Figure 1. Example of printout from a VISICALC model for simulating feral pig populations. Only 2 time periods are shown.

Figure 2. Sustained yield (A.) and instantaneous rate of increase (B.) implied by the natality and survivorship schedules incorporated in the feral pig model. Harvest rates (% of pre-harvest adult population) are indicated for selected points along each curve.

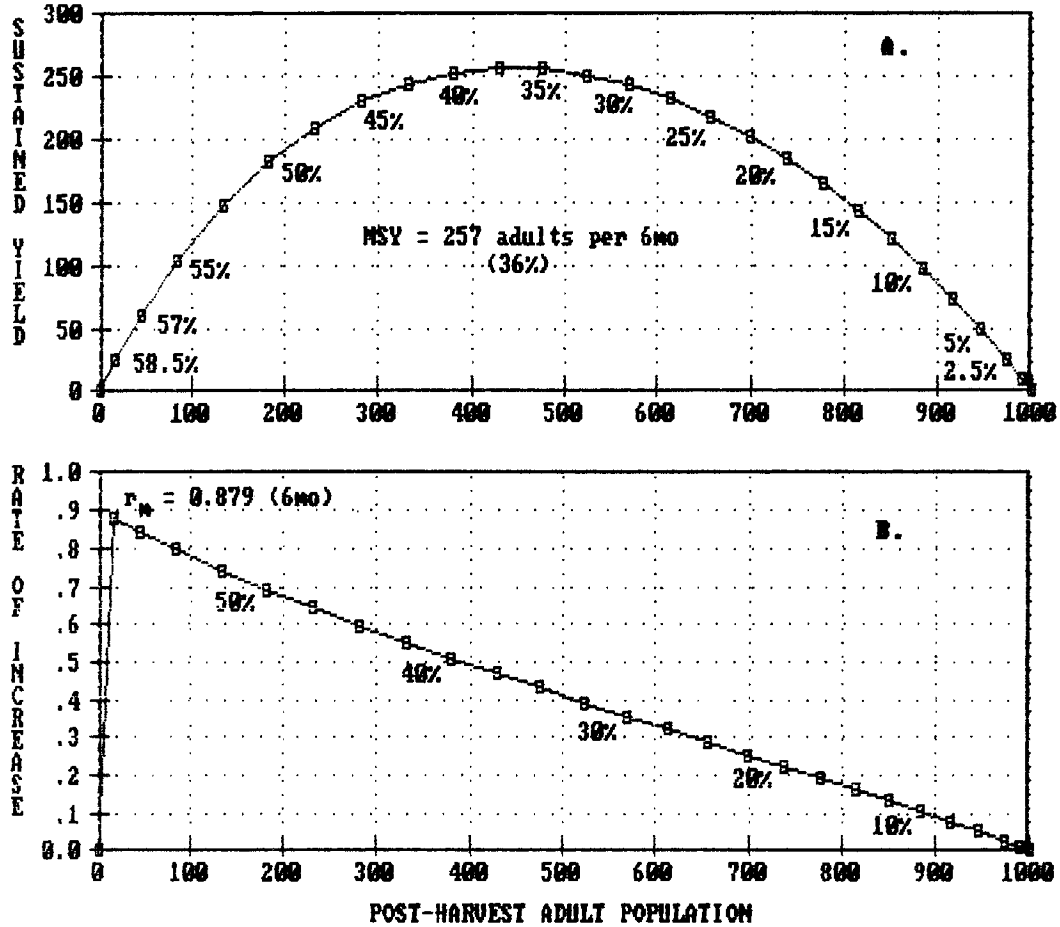
Figure 3. Simulated response of the Dye Creek feral pig population to random variation in the seasonal carrying capacity (A.) and in addition, sex-specific harvests as recorded by the Dye Creek Preserve (B.). Harvests prior to 1967 are estimates based on the record for 1967 at which time there was selection for trophy boars.

FERAL PIG POPULATION MODEL - SIX MONTH CYCLE - LINEAR DENSITY DEPENDENT REGULATION BY SEASONAL CARRYING CAPACITY - PERCENTAGE HARVEST
This version calculates starting (stable age) structure from given CC - ENTER CC HERE[K2](1000) AND PRESS !
Print instructions: /GFI/PP"^HOF^H5F 045 >W3 Use this template to set up a run; update legend before printing.

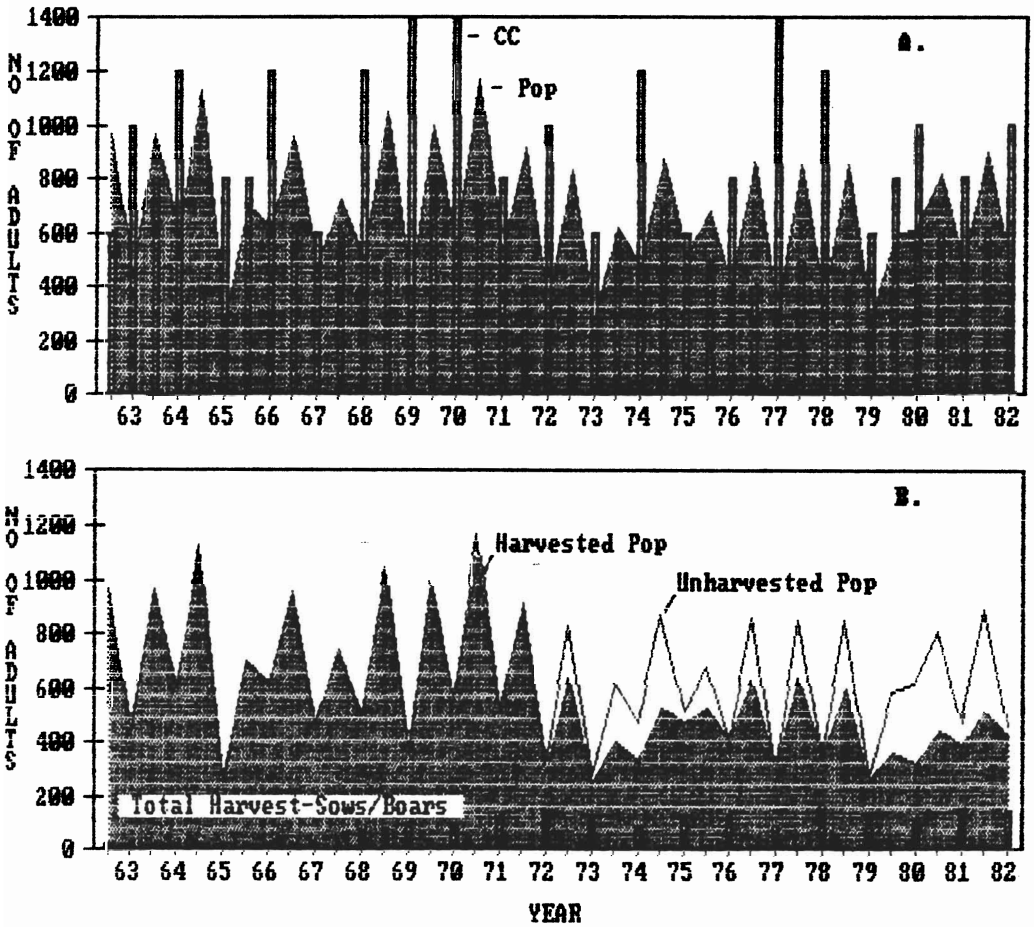
YEAR	M 6.5	M 6.0	M 5.5	M 5.0	M 4.5	M 4.0	M 3.5	M 3.0	M 2.5	M 2.0	M 1.5	M 1.0	M 0.5	TOTAL M
StartPop	2	5	8	12	17	23	28	33	39	46	58	77	153	500
.5	2	5	8	12	17	23	28	33	39	46	58	77	153	500

YEAR	F 6.5	F 6.0	F 5.5	F 5.0	F 4.5	F 4.0	F 3.5	F 3.0	F 2.5	F 2.0	F 1.5	F 1.0	F 0.5	TOTAL F
StartPop	2	5	8	12	17	23	28	33	39	46	58	77	153	500
.5	2	5	8	12	17	23	28	33	39	46	58	77	153	500

TOT 3+M	TOT 3+F	TOT AD	SEAS.CC	PreHvN/K	ADDPGL	TOTPGLTS	TOT POP	HvM T+1	HvF T+1	% Hv	PostHvN/K	B:100SOW	P:100SOW	R:100SOW
127	127	1000	1000	1.000019	1483	1918	2918	0	0	0	1.00	100	384	61
127	127	1000	1000	1.000019	1483	1918	2918	0	0	0	1.00	100	384	61



SUSTAINED YIELD
A.
MSY = 257 adults per 6mo
(36%)
58.5%
57%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
2.5%
RATE OF INCREASE
r_m = 0.879 (6mo)
B.
50%
40%
30%
20%
10%
POST-HARVEST ADULT POPULATION


A.
CC
Pop
B.
Harvested Pop
Unharvested Pop
Total Harvest-Sows/Boars
NO OF ADULTS
YEAR

APPENDIX

The following is a listing of the first 6 lines of a VISICALC template designed to model the dynamics of a harvested feral pig population. The alphanumeric designations to the left indicate the template cell into which the material following should be entered. Letters indicate columns (1-45).

```
 A1:"FERAL PIG
 B1:" POPULATI
 C1:"ON MODEL
 D1:"- SIX MON
 E1:"TH CYCLE
 F1:"- LINEAR
 G1:"DENSITY D
 H1:"EPENDENT
 I1:"REGULATIO
 J1:"N BY SEAS
 K1:"ONAL CARR
 L1:"YING CAPA
 M1:"CITY - AB
 N1:"SOLUTE HA
 O1:"RVEST
 P1:">P3 /PP"^
 Q1:"HOF^H5F A
 R1:"D45 >AL3
AE1:">AE3 /PP"
AF1:"^HOF^H5F
AG1:"AS45
 A2:"This vers
 B2:"ion calcu
 C2:"lates sta
 D2:"rting (st
 E2:"able age)
 F2:" structur
 G2:"e from gi
 H2:"ven CC -
 I2:"ENTER CC
 J2:"HEREK2(
 K2:1000
 L2:") AND PRE
 M2:"SS !
 A3:"Print ins
 B3:"tructions
 C3:": /GFI/PP
 D3:""^HOF^H5F
 E3:" 045 >W3
 F3:"Use this
 G3:"template
 H3:"to set up
 I3:" a run; u
 J3:"pdate leg
 K3:"end befor
```

```
 L3:"e printin
 M3:"g.
 A4:"    YEAR
 B4:"     M 6.5
 C4:"     M 6.0
 D4:"     M 5.5
 E4:"     M 5.0
 F4:"     M 4.5
 G4:"     M 4.0
 H4:"     M 3.5
 I4:"     M 3.0
 J4:"     M 2.5
 K4:"     M 2.0
 L4:"     M 1.5
 M4:"     M 1.0
 N4:"     M 0.5
 O4:"  TOTAL M
 P4:"    YEAR
 Q4:"     F 6.5
 R4:"     F 6.0
 S4:"     F 5.5
 T4:"     F 5.0
 U4:"     F 4.5
 V4:"     F 4.0
 W4:"     F 3.5
 X4:"     F 3.0
 Y4:"     F 2.5
 Z4:"     F.2.0
AA4:"     F 1.5
AB4:"     F 1.0
AC4:"     F 0.5
AD4:"  TOTAL F
AE4:"  TOT 3+M
AF4:"  TOT 3+F
AG4:"   TOT AD
AH4:"  SEAS.CC
AI4:" PreHvN/K
AJ4:"   ADDPGL
AK4:" TOTPGLTS
AL4:"  TOT POP
AM4:"  HvM T+1
AN4:"  HvF T+1
AO4:"     % Hv
AP4:"PostHvN/K
AQ4:" B:100SOW
AR4:" P:100SOW
AS4:" R:100SOW
 A5:" StartPop
 B5:+K2*.001852023
 C5:+K2*.004630101
 D5:+K2*.007716883
 E5:+K2*.011872190
 F5:+K2*.016960370
 G5:+K2*.022613940
```

```
 H5:+K2*.028267520
 I5:+K2*.033255980
 J5:+K2*.039124760
 K5:+K2*.046029230
 L5:+K2*.057536740
 M5:+K2*.076715940
 N5:+K2*.153433600
 O5:@SUM(B5...N5)
 P5:" StartPop
 Q5:+B5
 R5:+C5
 S5:+D5
 T5:+E5
 U5:+F5
 V5:+G5
 W5:+H5
 X5:+I5
 Y5:+J5
 Z5:+K5
AA5:+L5
AB5:+M5
AC5:+N5
AD5:@SUM(Q5...AC5)
AE5:@SUM(B5...I5)
AF5:@SUM(Q5...X5)
AG5:@IF((O5+AD5)<=0,0,(O5+AD5))
AH5:+K2
AI5:/FG+AG5/AH5
AJ5:((Q5+Z5)*(6.6-(.4*AI5)))+
    ((R5+Y5)*(7.0-(.3*AI5)))+
    ((S5+X5)*(7.4-(.3*AI5)))+
    ((T5+W5)*(7.7-(.3*AI5)))+
    ((U5+V5)*(8.0-(.3*AI5)))
AK5:(AA5*(6.1-(1.2*AI5)))+
    (AB5*(5.0-(3.0*AI5)))
AL5:+AG5+AK5
AM5:+AG5*0/2
AN5:+AM5
AO5:(AM5+AN5)/AG5*100
AP5:/F$(AG5-(AM5+AN5))/AH5
AQ5:+O5*(100/AD5)
AR5:+AK5*(100/AD5)
AS5:(N5+AC5)*(100/AD5)
 A6:/FG+.5
 B6:(C5-((C5/O5)*AM5))*(.60-(.20*AP5))
 C6:(D5-((D5/O5)*AM5))*(.80-(.20*AP5))
 D6:(E5-((E5/O5)*AM5))*(.85-(.20*AP5))
 E6:(F5-((F5/O5)*AM5))*(.90-(.20*AP5))
 F6:(G5-((G5/O5)*AM5))*(.95-(.20*AP5))
 G6:(H5-((H5/O5)*AM5))*(.95-(.15*AP5))
 H6:(I5-((I5/O5)*AM5))*(.95-(.10*AP5))
 I6:(J5-((J5/O5)*AM5))*(.95-(.10*AP5))
 J6:(K5-((K5/O5)*AM5))*(.95-(.10*AP5))
 K6:(L5-((L5/O5)*AM5))*(.95-(.15*AP5))
```

```
 L6:(M5-((N5/O5)*AM5))*(.90-(.15*AP5))
 M6:@IF(((N5-((N5/O5)*AM5))*(.80-(.30*AP5)))<=
     0,0,((N5-((N5/O5)*AM5))*(.80-(.30*AP5))))
 N6:@IF(((AK5/2)*(.70-(.54*AP5)))<=0,0,
     ((AK5/2)*(.70-(.54*AP5))))
 O6:@SUM(B6...N6)
 P6:/FG+.5
 Q6:(R5-((R5/AD5)*AN5))*(.60-(.20*AP5))
 R6:(S5-((S5/AD5)*AN5))*(.80-(.20*AP5))
 S6:(T5-((T5/AD5)*AN5))*(.85-(.20*AP5))
 T6:(U5-((U5/AD5)*AN5))*(.90-(.20*AP5))
 U6:(V5-((V5/AD5)*AN5))*(.95-(.20*AP5))
 V6:(W5-((W5/AD5)*AN5))*(.95-(.15*AP5))
 W6:(X5-((X5/AD5)*AN5))*(.95-(.10*AP5))
 X6:(Y5-((Y5/AD5)*AN5))*(.95-(.10*AP5))
 Y6:(Z5-((Z5/AD5)*AN5))*(.95-(.10*AP5))
 Z6:(AA5-((AA5/AD5)*AN5))*(.95-(.15*AP5))
AA6:(AB5-((AB5/AD5)*AN5))*(.90-(.15*AP5))
AB6:@IF(((AC5-((AC5/AD5)*AN5))*(.80-(.30*AP5)))<=
     0,0,((AC5-((AC5/AD5)*AN5))*(.80-(.30*AP5))))
AC6:+N6
AD6:@SUM(Q6...AC6)
AE6:@SUM(B6...I6)
AF6:@SUM(Q6...X6)
AG6:@IF((O6+AD6)<=0,0,(O6+AD6))
AH6:+K2
AI6:/FG+AG6/AH6
AJ6:((Q6+Z6)*(6.6-(.4*AI6)))+
     ((R6+Y6)*(7.0-(.3*AI6)))+
     ((S6+X6)*(7.4-(.3*AI6)))+
     ((T6+W6)*(7.7-(.3*AI6)))+
     ((U6+V6)*(8.0-(.3*AI6)))
AK6:(AA6*(6.1-(1.2*AI6)))+
     (AB6*(5.0-(3.0*AI6)))
AL6:+AG6+AK6
AM6:+AG6*0/2
AN6:+AM6
AO6:(AM6+AN6)/AG6*100
AP6:/F$(AG6-(AM6+AN6))/AH6
AQ6:+O6*(100/AD6)
AR6:+AK6*(100/AD6)
AS6:(N6+AC6)*(100/AD6)
```

HOW TO RUN THE FERAL PIG MODEL (TEMPLATE) ON VISICALC (IBM-PC)

1. Load VISICALC program disk in left drive (A) and the data disk with the template in the right drive (B).

2. Turn on the computer and the printer. The VISICALC disk can be removed for safekeeping when drive A stops.

3. Load the program into RAM; watch as the byte indicator in the top right corner displays the declining space ramaining in RAM; an exclamation point will display while the model is making its initial run. {6 min}

   TYPE /SL CapsLock B:FPMODEL.VC <E>, where <E> means enter

4. Determine carrying capacity (CC=K) for unharvested population for the area of interest and enter value at K2. Run model to establish stable age distribuition of unhunted population in a stable environment. {3 min}

   TYPE >K2 <E>
   [carrying capacity value] <E>
   !

5. Check to see if the "PreHvN/K" column has stabilized to a series of equal values (column AI should read 1.000019 if the population stabilizes at CC) for at least several lines. If so, proceed to Step 7; if not, repeat Step 6 as necessary until the above cirteria are met. This should not be necessary if the harvest columns (AM, AN) remain set to zero as the template automatically calculates the stable age distribution at CC. {0.5 min}

   TYPE >AN45 <E>

6. This step describes the procedure for continuing a modeling run for an additional 20 years by "recycling" the bottom row of the spreadsheet matrix to the top row. The process can be repeated indefinitely. If printouts are made for each cycle they should have the appropriate starting year (y) entered at A5 and F5 before printing (see Step 9 for printing instructions). Also, the beginning row, such as the initial stable age distribution, may also be saved in a similar manner if additional runs beginning with this population structure are envisioned (the mechanism for establishing the initial structure is lost after the first recycling). A "scratch disk" may be used to temporarily save data interchange format (DIF) files during the recycling process rather than cluttering up the main template disk (note that only 3 copies of the template will fit on a double-sided disk so there is not much room left over for miscellaneous files). Replace the pig model (template) disk with a scratch disk now (Drive B). {3 min per cycle}

```
TYPE  /S#SB:[filename eg.P1H0Y20 for pop 1,0 harvest,yr 20]<E>
      AS45 <E>
      R
      >A5 <E>
      /S#LB:[filename or -> to see fn on prompt line] <E>
      R
      (Return to Step 5)
```

7. To determine the effect of varying carrying capacity you can enter any series of values (K) desired into column AH. For example, you could use percentage deviations from normal rain fall to modify the average carrying capacity seasonally. Or, you could simply use random numbers generated for any desired frequency distribution(s). {4 min}

```
TYPE  >AH5
      [K1]!
      [K2]!
        :
      [K45]!
```

8. When you are satisfied with a particular sequence of seasonal carrying capacities, whether constant or varied in some fashon, you can look at the effect of harvesting adult (6+mo) pigs on a nonselective basis (ie. all sex and age classes are harvest in exact proportion to their occurrence in the pre-harvest population). The impact of harvesting will be most clear when carrying capacity is held constant. Harvests may be entered as 1) a percentage of the adult population, 2) a constant number over time, or 3) a series of any values desired (as might be the case if mimicing a historically recorded harvest pattern). The model will also accomodate sex specific harvests (but still no selection for age) by entering different values in columns AM and AN. It is relatively easy to modify the model (template) to provide for age as well as sex specific harvests if desired, but that procedure will not be covered here. To harvest a given percentage of the adult population each season (eg. 30%) proceed by editing the "HvM T+1" column (AM) and running the model. {3 min}

```
TYPE  >AM5 <E>
      /E->->->->->->Del.3 <E>
      /R <E>
      AM6.AM45 <E>
      R
      !          (Note: when entering starting population
                  structure from a DIF file manual
                  recalculation is unnecessary here)
```

If you wish to determine how many years are required to develop a stable age distribution, check column AI for the year in which the "PreHvN/K" ratio becomes fixed. If it is still changing by year 20 then proceed to the recycling manoeuver described in Step 6; repeat as necessary to obtain a stable age distribution.

To harvest a variable number of individuals over time simply enter the desired values in column AM (if both sexes harvested equally), or columns AM and AN for boars and sows, respectively. Run the model by typing "!".

9. The cheapest way to see the results of a run is to scroll around the spreadsheet. To obtain a "hard copy" of what you see you may print the entire spreadsheet matrix on two 8.5x11" pages by breaking the matrix into three equal sections as follows. Note that the same instructions can be followed directly on the screen as they are encorporated in the template heading. {6 min}

```
TYPE  Home
      /PP"^HOF^H5F <E>
      045 <E>          (Note: wait a minute for printer)
      >W3 <E>
      >P3 <E>
      /PP"^HOF^H5F <E>
      AD45 <E>
      >AL3 <E>
      >AE3 <E>
      /PP"^HOF^H5F <E>
      AS45 <E>         (Note: advance printer paper 1 line to
                        the top of the next page)
```

10. To construct a yield curve (of the various absolute harvests that can be sustained by increasing percentage harvest rates, for example), make a series of runs, each for a given harvest rate (say 2.5% increments). You may need to recycle up to several times, especially with the higher harvest rates, which take over 100 years to reach a stable age distribution. Since a recycle forces a spreadsheet recalculation you should set up any new harvest schedule prior to recycling the beginning age structure. To keep a record of each run you can print a hard copy. Be sure to note the starting year if not zero at A5 and P5 (and the ending year at A45 and P45) before printing. Also, if you wish to graph the population trend (or that of any other statistic) over the time it takes the age structure to stabilize for a given harvest rate you must also save the appropriate column(s) (AG for adult population) in DIF files for transfer to VISIPLOT. The following listing is the recommended sequence for determining the stable age distribution for a harvest rate of 47.5%; it involves one recycling. It assumes you are starting with the pig model template loaded, but no harvest rate has been specified yet. Finally, it assumes that a scratch disk is in drive B with a DIF file [B:DCFP0.DIF] for the stable age distribution at CC. {20 min}

```
TYPE  >AM6 <E>
```

```
/E->->->->->->Del.475 <E>
/R <E>
AM7.AM45 <E>
R                            (Note: wait few seconds)
>A5 <E>
/S#LB:-> <E>
R                            (Note: wait two minutes)
Home
/PP"^HOF^H5F <E>
O45 <E>                      (Note: wait two minutes)
>W3 <E>
>P3 <E>
/PP"^HOF^H5F <E>
AD45 <E>                     (Note: wait two minutes)
>A13 <E>
>AE3 <E>
/PP"^HOF^H5F <E>
AS45 <E>                     (Note: wait two minutes)
>AG4 <E>
/S#SB:DC475X1 <E>
AG45 <E>
C                            (Note: wait few seconds)
>A45 <E>
/S#SB:X1 <E>
```

(Note: if a DIF file [B:X1.DIF] already exists from a prior recycle just type "Y" and continue since this file space will always represent one row of the matrix and thus remain the same size)

```
AS45 <E>
R                             (Note: wait a few seconds)
>A5 <E>
/S#LB:X1.DIF <E>
R                             (Note: wait two minutes)
20 <E>
>P5 <E>
20 <E>
```

(Note: another round of printing would normally be done here requiring about 6 minutes; see Step 9)

```
>AG5 <E>
/S#SB:DC475X2 <E>
AG45 <E>
C                             (Note: wait a few seconds)
```

(Note: scroll down column AI until you reach the top row of a stable series; scroll left to column P to read the year; remember to add 20 years to this value for total years necessary for the model structure to stabilize--this will be some time after the intiger values stabilize on the printout since the N/K ratio is carried to 8 decimal places)

>P45 <E>
[years to stabilize] <E>
>A45 <E>
[years to stabilize] <E>
/S#SB:DCFP475 <E>
AS45 <E>
R (Note: wait a few seconds)

(Note: now you should have 1) printouts of the matrix over a total of 40 years, 2) two DIF files [B:DC475X1.DIF and B:DC475X2.DIF] that can be combined to graph population trend over 40 years using VISIPLOT, and 3) a DIF file [B:DCFP475.DIF] that can be entered into a new VISICALC template that will include all files (stable age distributions) for the set of harvests simulated)

11. Once you have finished all the runs you wish to make with VISICALC for the time being you may want to produce graphs of certain statistics over time, such as the trend in adult population. This is accomplished most easily if you have remembered to save all the columns of data you expect to graph in DIF files. Assuming you have two such files for the trend of adult population over two 20-year periods and want to graph them as one 40-year sequence, you are now ready to switch from VISICALC to VISIPLOT. If you have not already removed the VISICALC program diskette from drive A replace it now with the first VISIPLOT diskette. Make sure the printer color monitor are on. If you are using a TV set instead of a color monitor turn it on. Now depress the Ctrl and Alt keys while pressing the Del key to start loading the VISIPLOT program. In a few seconds when instructions appear on the monitor, replace the first VISIPLOT diskette with the second in drive A and press <E>. The scratch disk with DIF files should remain in drive B. If you wish to save any graphics on disk as well as making printed copies you must make sure there is room (16000K per graph) on the scratch disk or have another formatted disk ready just for graphics. Attempting to save a graph on a full disk will destroy both the graph and possible some other material on the disk.

VISIPLOT commands are used differently than those of VISICALC in that the entire program is manipulated via a series of hierarchical menus, each displaying all the available commands in English. Commands may be invoked by moving the cursor to the desired action and pressing <E>, or by typing the first two letters of the command, in which case it will be activated immediately without having to press <E>.

TYPE LOAD <E>

(Note: scroll down list of DIF files until you locate the cursor on the first one with data you wish to graph; press <E>; you can load only one file at a time although a file may contain several series (columns of data); if the file does contain multiple series you must repeat the following initialization procedure for each series in the file; if your file is not on the first screen use [more] to move on to the next set of files on the disk)

B:DC475X1.DIF <E>	
2 <E>	(Note: periodicity is 2 6-mo periods per year)
1962 <E>	(Note: starting year for series)
2 <E>	(Note: minor start period is 2nd half of 1962)
EXIT <E>	
LOAD <E>	
B:DC475X2.DIF <E>	
2 <E>	
1962 <E>	
2 <E>	
EXIT <E>	
EDIT <E>	
TOT AD <E>	(Note: this series is already titled because you included the title by saving the DIF file from AG4 rather than AG5)
ESC <E>	
JUMP <E>	(Note: move cursor down to space below last entry in series)
ESC <E>	(Note: edit menu appears)
FILL <E>	
SERIES1 <E>	(Note: second series of values is added to bottom of first and the cursor is placed at the last entry of the first series)
ESC <E>	
DELETE <E>	(Note: you must remove one of the pair of identical values as both are for year 20 of the run)
ESC <E>	
EXIT <E>	
CLEAR <E>	(Note: move cursor down to SERIES1 and press space bar then <E> to remove excess data from RAM; you could also SAVE the newly expanded file in normal or DIF format if you expect to use it again)
PLOT <E>	(Note: the plot menu appears)
LINE <E>	
TOT AD <E>	
PLOT <E>	(Note: line graph displayed on color monitor or TV screen)

(Note: at this point numerous additional embellishments can be added to the graph including superimposing many other trend lines; options are so numerous that you should become familiar with the VISIPLOT user's manual to make full use of them; here we will assume the graph is ready for printing; advance the printer paper 7 lines to center the graph on the page)

ESC <E>
PRINT <E>
DRIVER <E> (Note: wait a minute for driver menu)
IBM 80CPS MATRIX NORMAL SIZE HIGH DENS 90 DEG ROT <E>
YES <E> (Note: automatic line feed)
PRINT <E> (Note: ensure printer is "on line" to get action)

(Note: if and when the graph is acceptable you can store a copy of it on disk as follows:)

SCREEN <E>
SAVE <E> (Note: wait a minute for list of PIX files)
[NEW FILE] <E>
[filename] (Note: eg. ADULTPOP)

The graphing process is now complete and you can quit or repeat any of the routines desired. Make sure you make backup copies of all important data on separate disks; they have a habit of failing just when you don't have time or forget to do the job right. You can enter DOS directly from VISIPLOT without retyping date and time by working up the menus with EXIT and QUIT commands.

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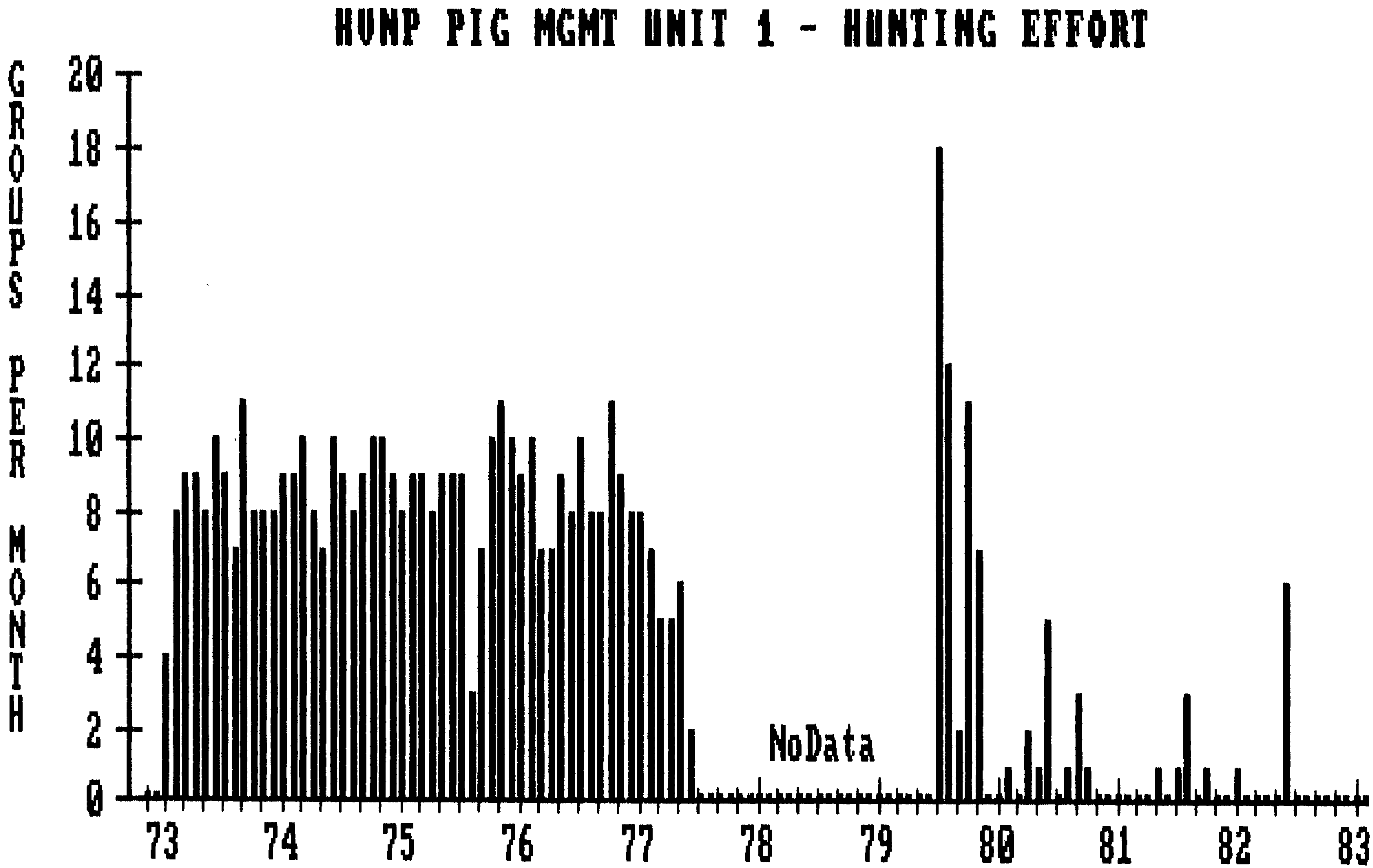
APPENDIX C.

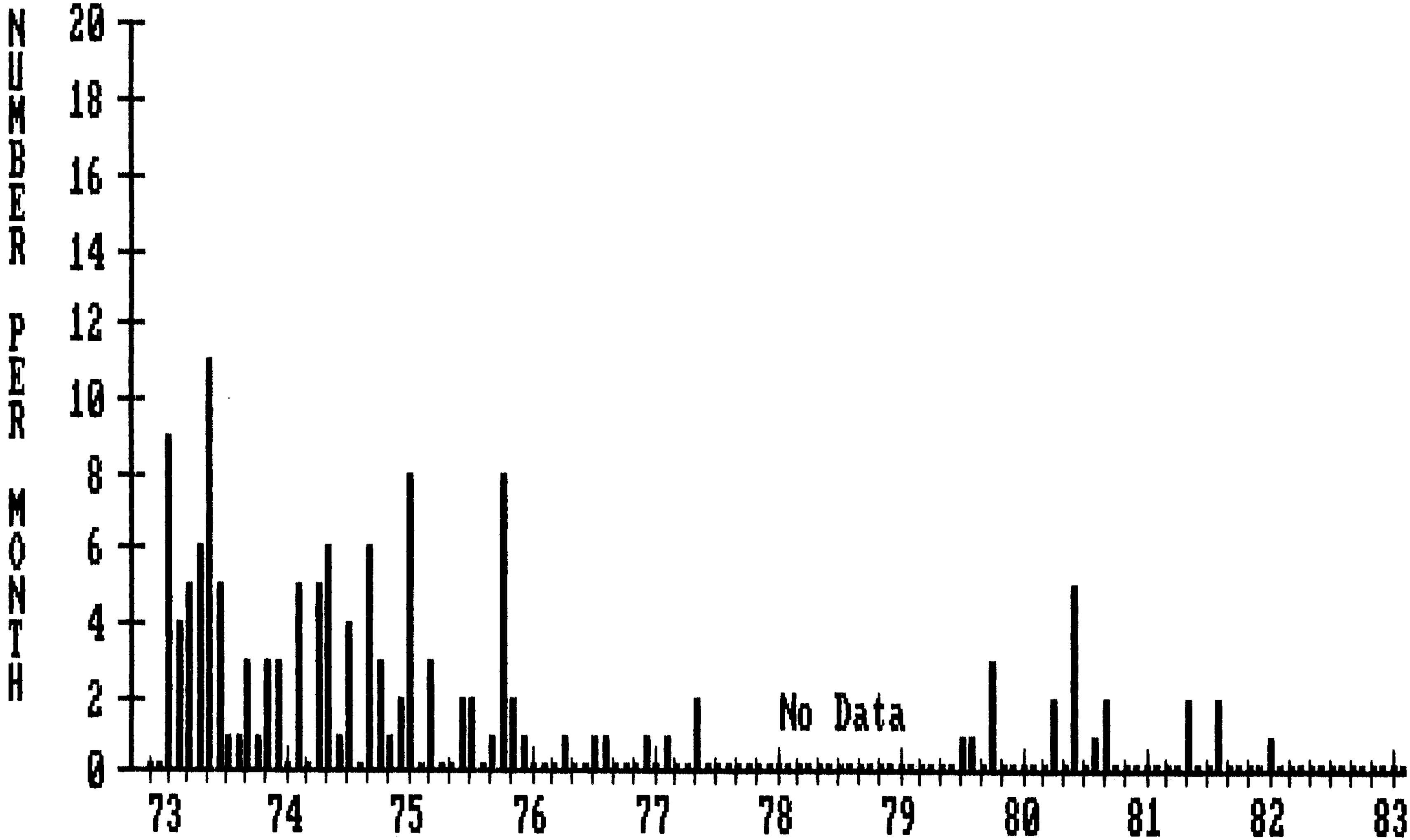
GRAPHICAL PRESENTATION OF DATA FOR THE DEPUTY RANGER PROGRAM

The following graphs were constructed from a portion of the data base listed in APPENDIX A. Monthly data are summarized for sub-regions and the entire Park on a three-month bases also.

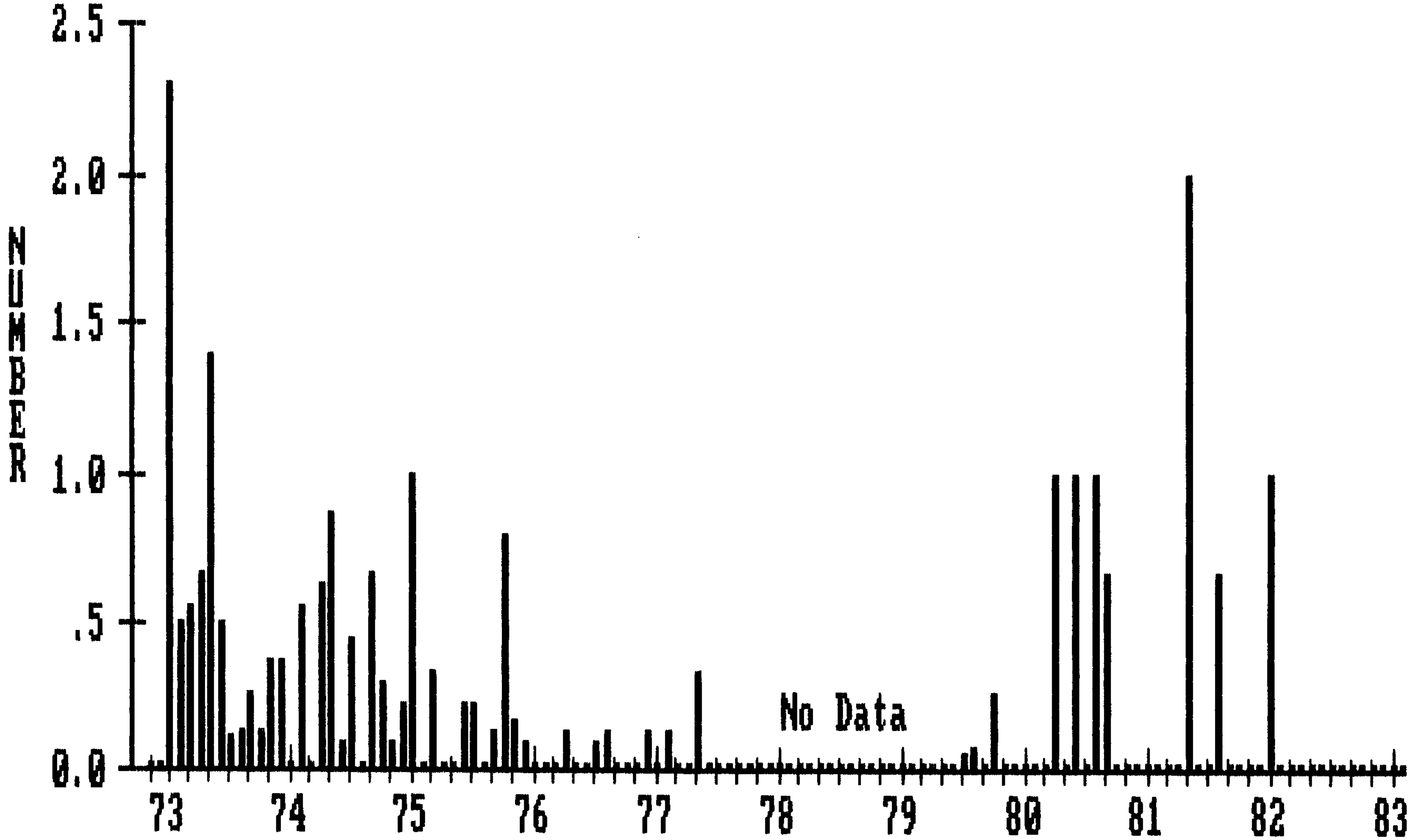

HVNP PIG MGMT UNIT 1 - HUNTING EFFORT
GROUPS PER MONTH
20
18
16
14
12
10
8
6
4
2
0
NoData
73
74
75
76
77
78
79
80
81
82
83

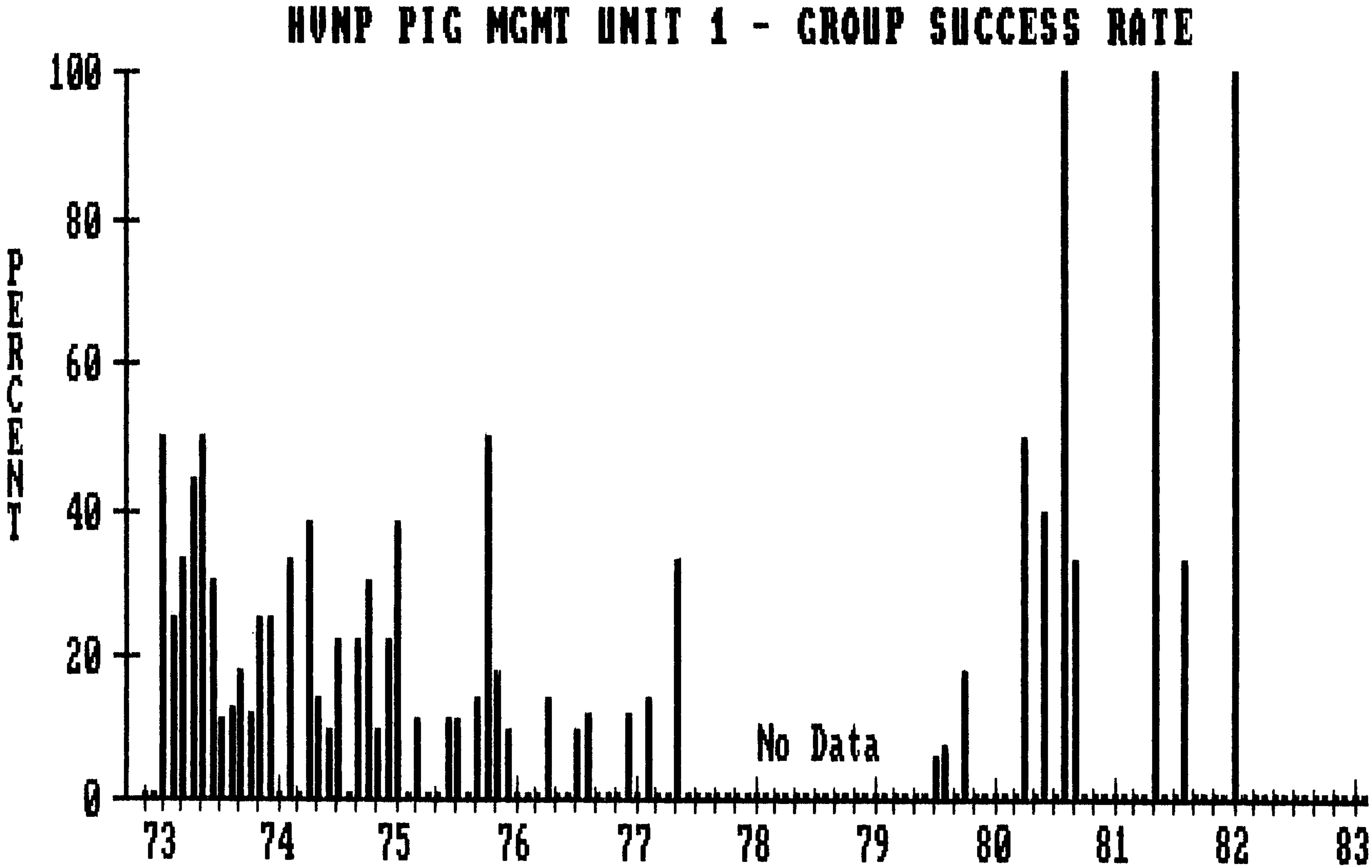
1

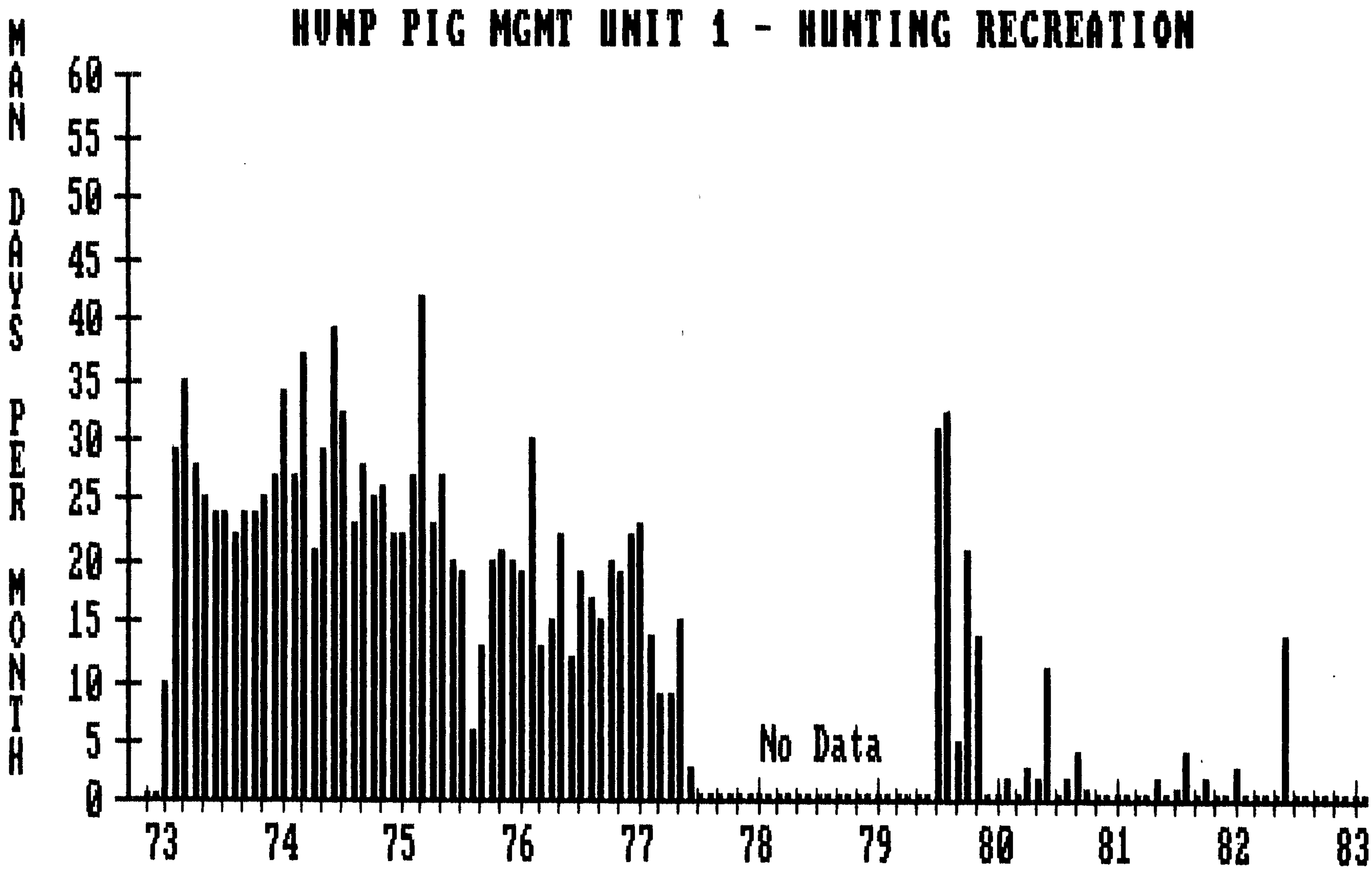
HUNP PIG MGMT UNIT 1 - RECORDED KILL

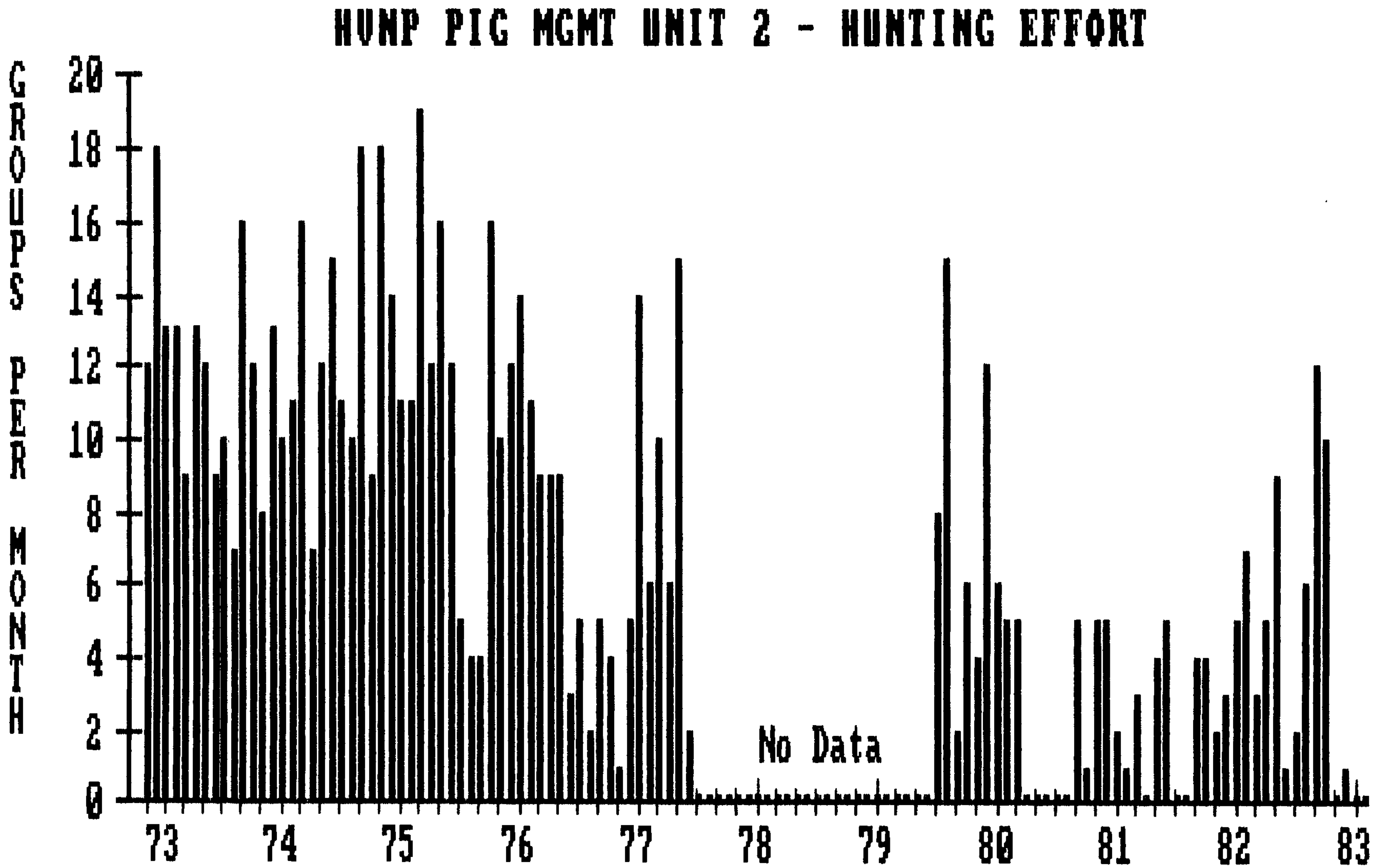


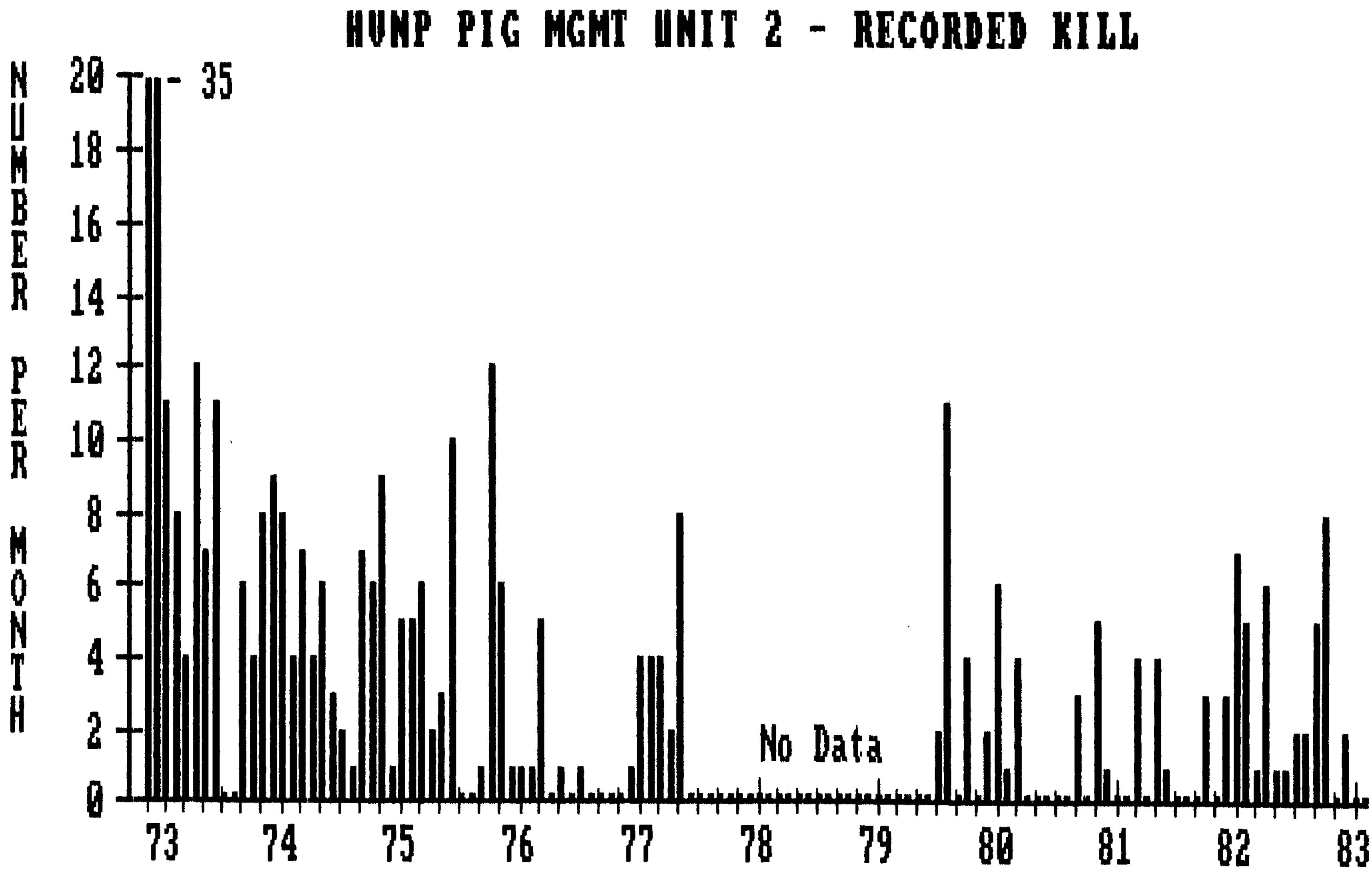
HVNP PIG MGMT UNIT 1 - MEAN PIGS PER GROUP



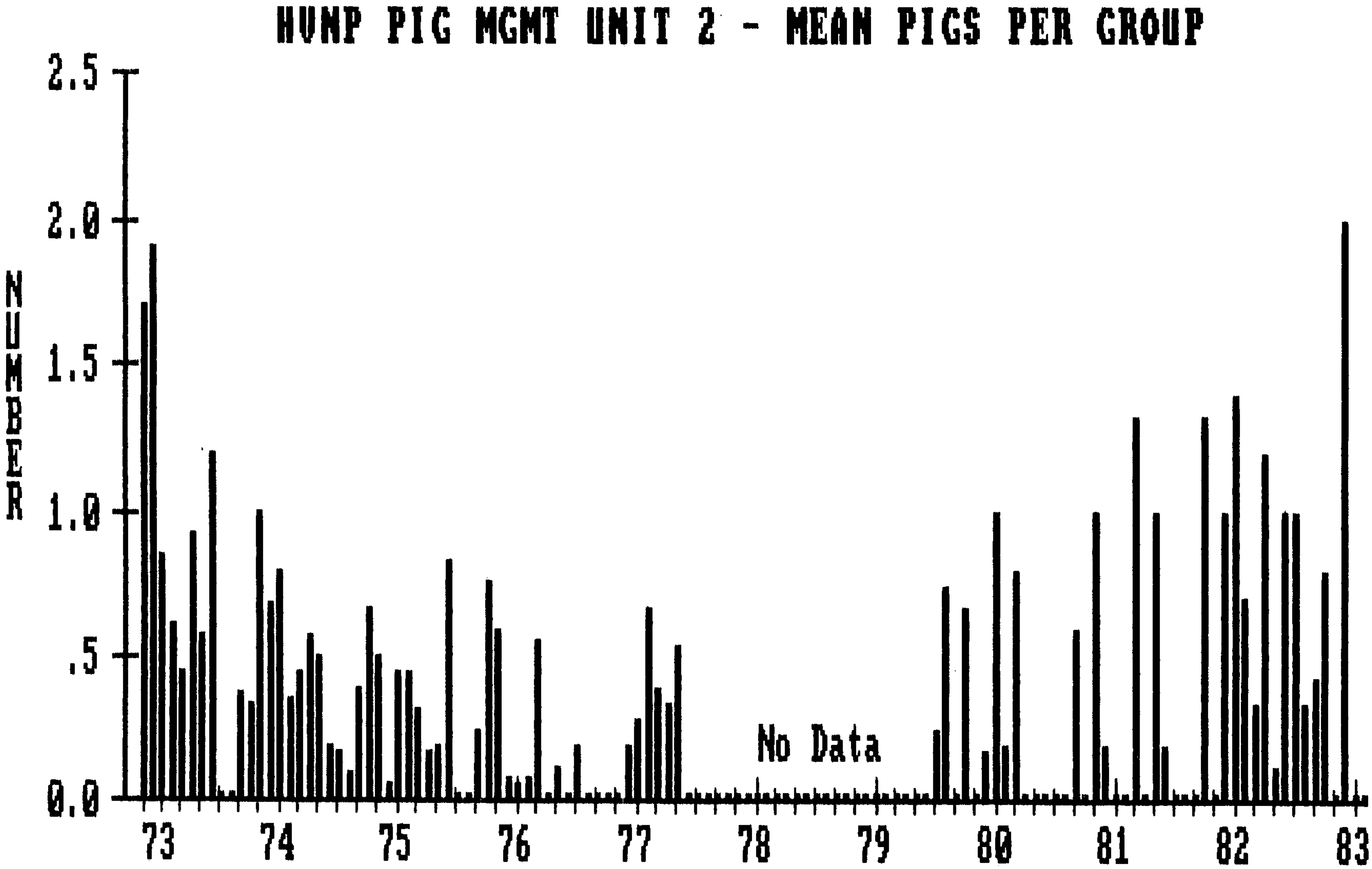

HVNP PIG MGMT UNIT 1 - GROUP SUCCESS RATE
PERCENT
100
80
60
40
20
0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 1 - HUNTING RECREATION
MAN DAYS PER MONTH
0
5
10
15
20
25
30
35
40
45
50
55
60
No Data
73
74
75
76
77
78
79
80
81
82
83

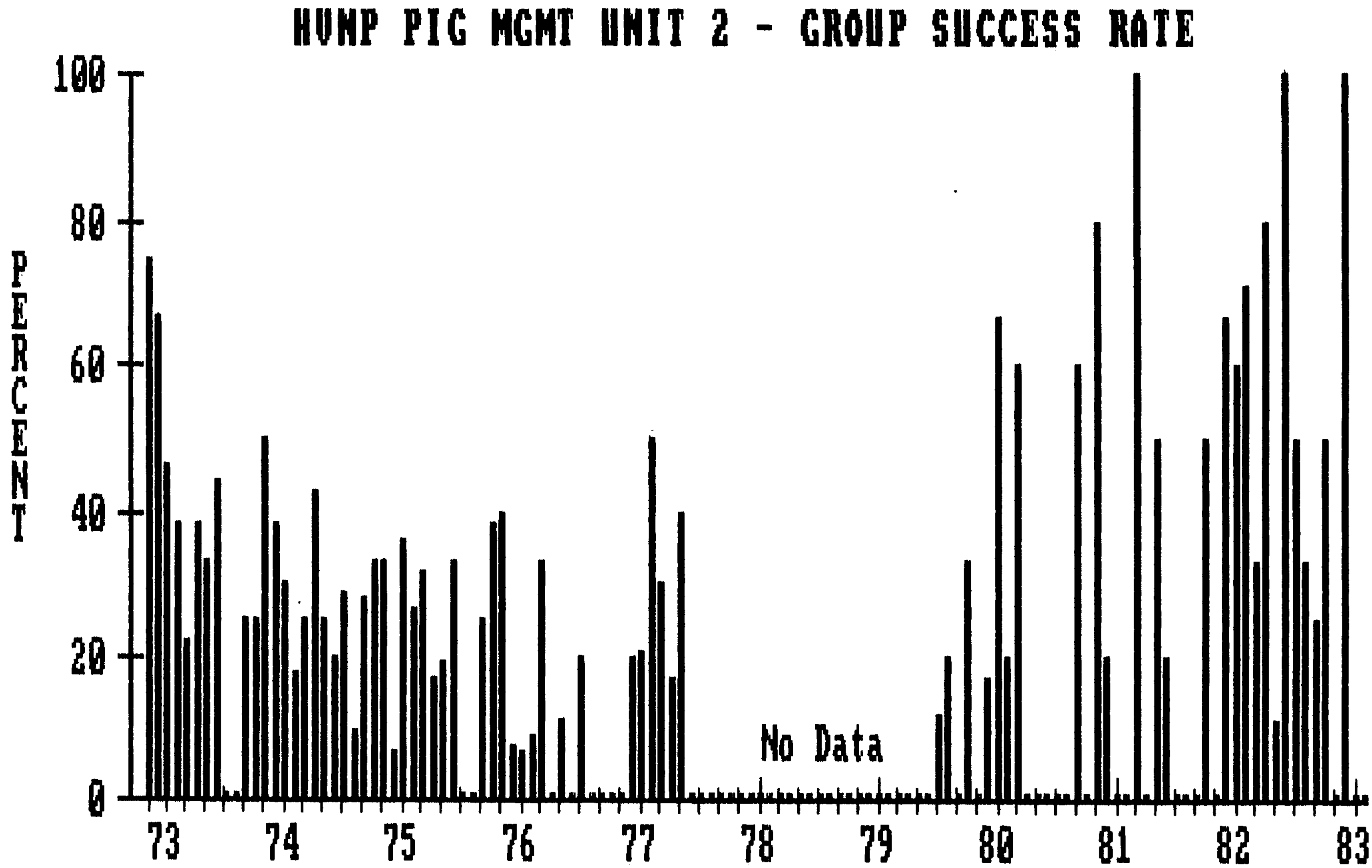

HVNP PIG MGMT UNIT 2 - HUNTING EFFORT
GROUPS PER MONTH
0
2
4
6
8
10
12
14
16
18
20
No Data
73
74
75
76
77
78
79
80
81
82
83



HUNP PIG MGMT UNIT 2 - RECORDED KILL
NUMBER PER MONTH
0
2
4
6
8
10
12
14
16
18
20
- 35
No Data
73
74
75
76
77
78
79
80
81
82
83



HVNP PIG MGMT UNIT 2 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 2 - GROUP SUCCESS RATE
PERCENT
100
80
60
40
20
0
No Data
73
74
75
76
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80
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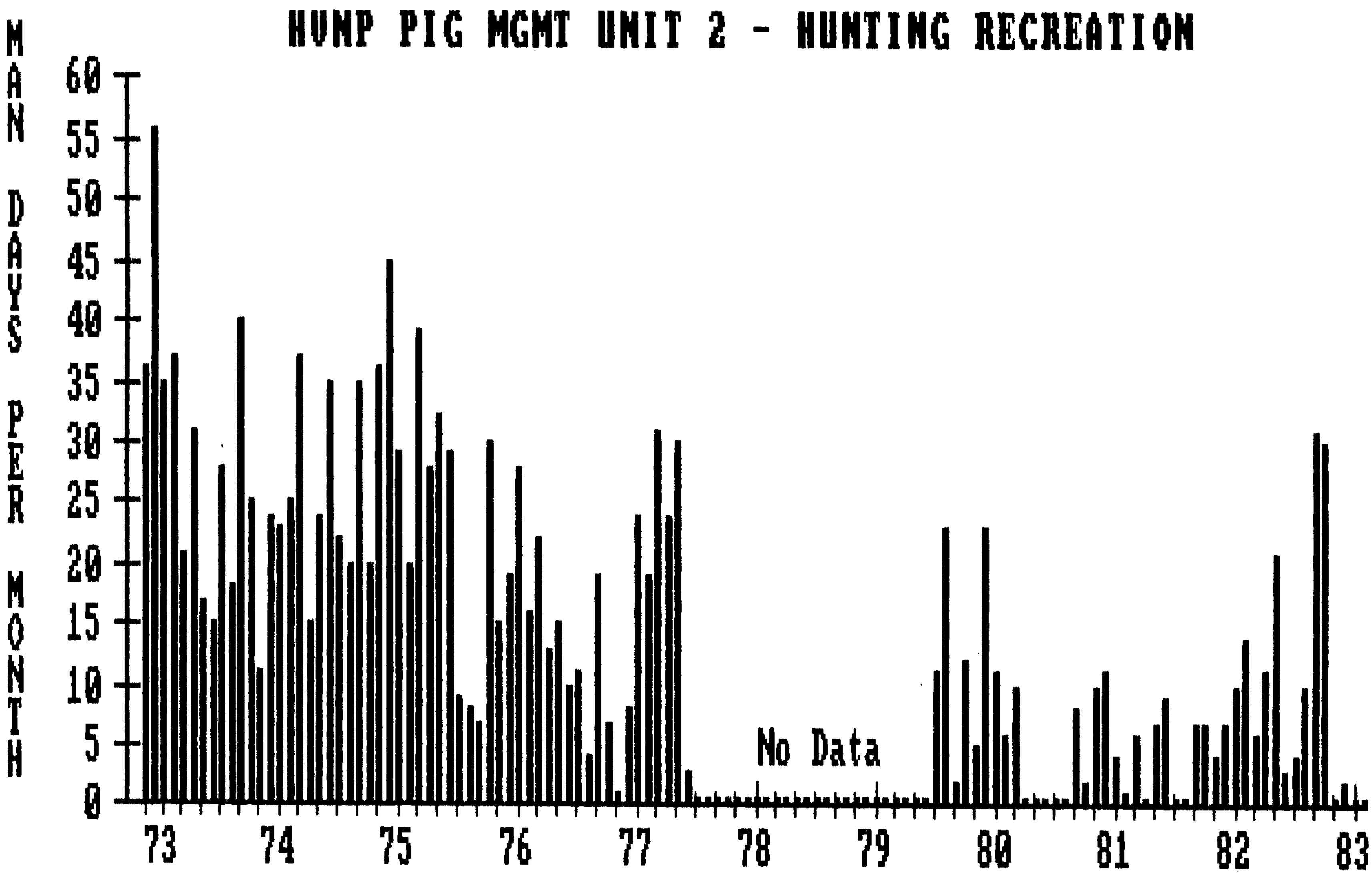
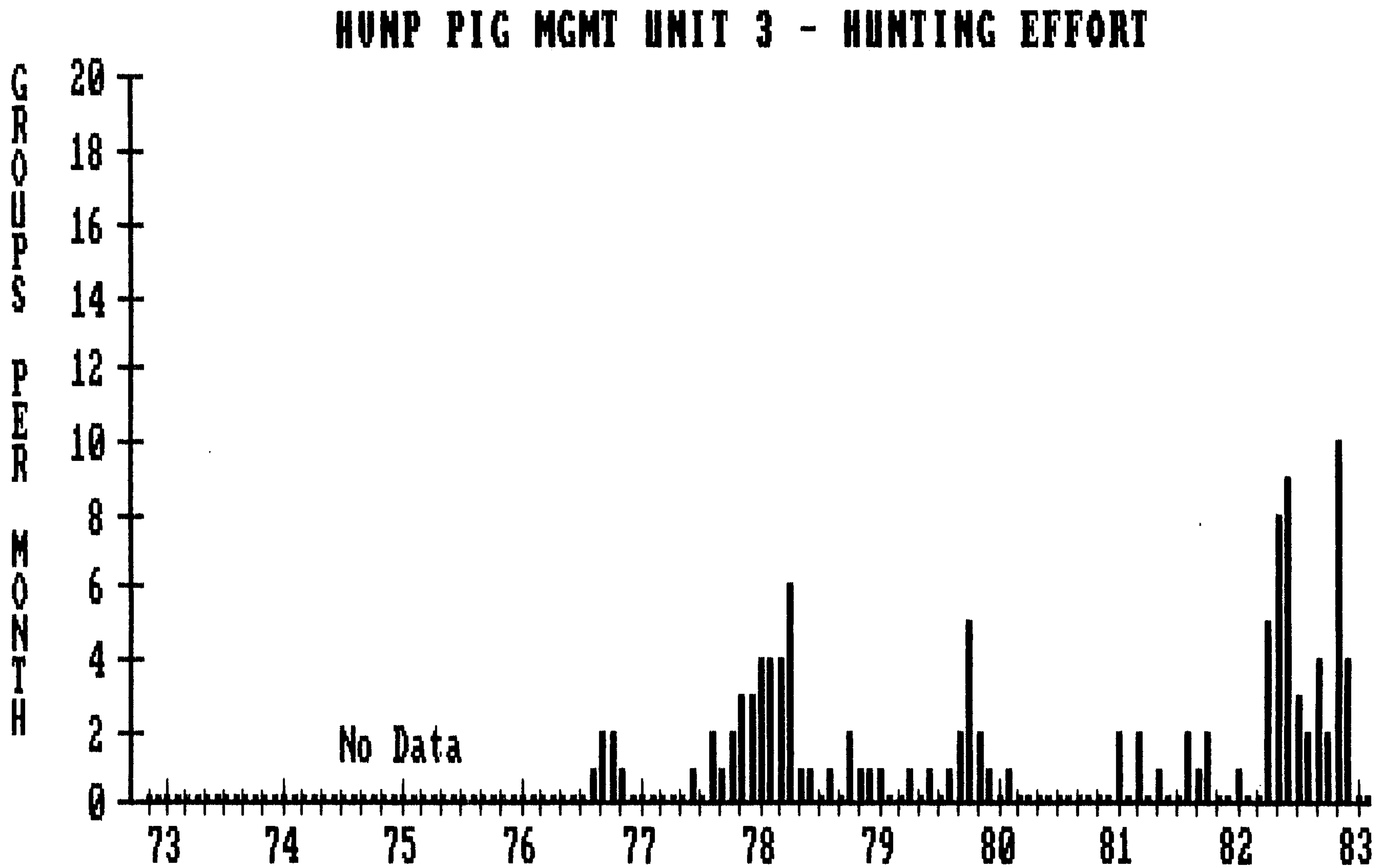
82
83


HVNP PIG MGMT UNIT 2 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 3 - HUNTING EFFORT
GROUPS PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
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76
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78
79
80
81
82
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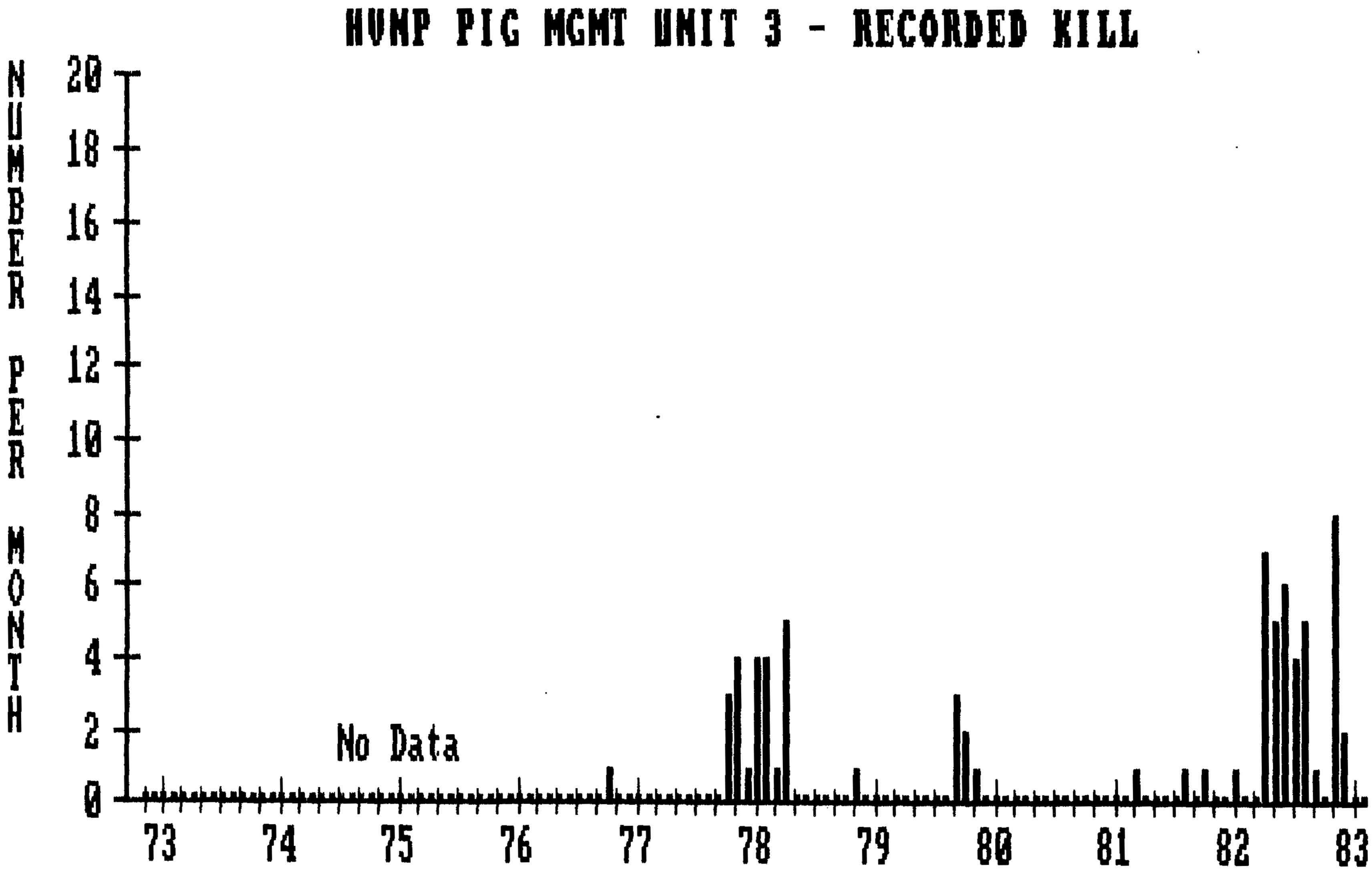
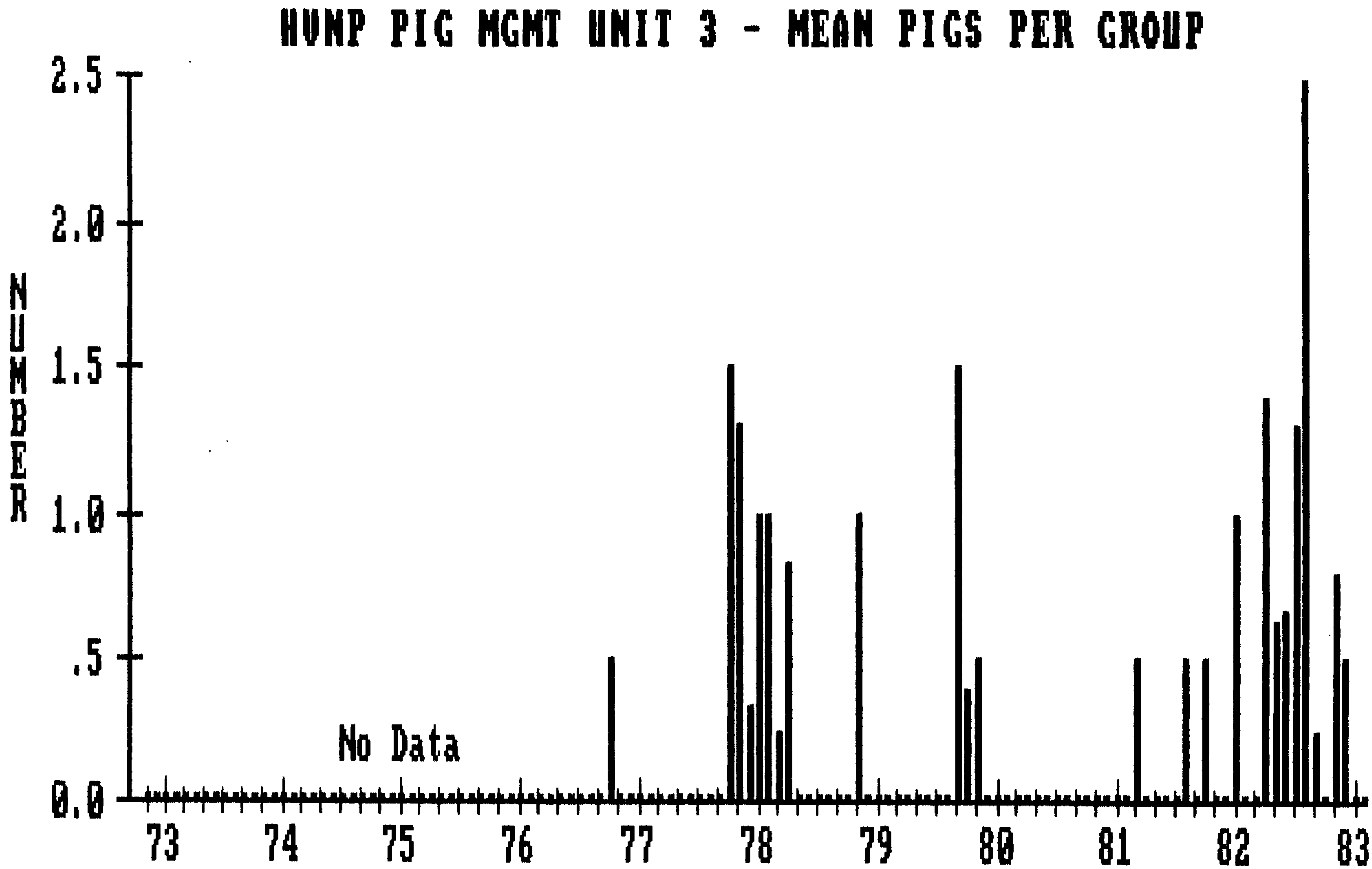


HVNP PIG MGMT UNIT 3 - RECORDED KILL
NUMBER PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 3 - MEAN PIGS PER GROUP
NUMBER
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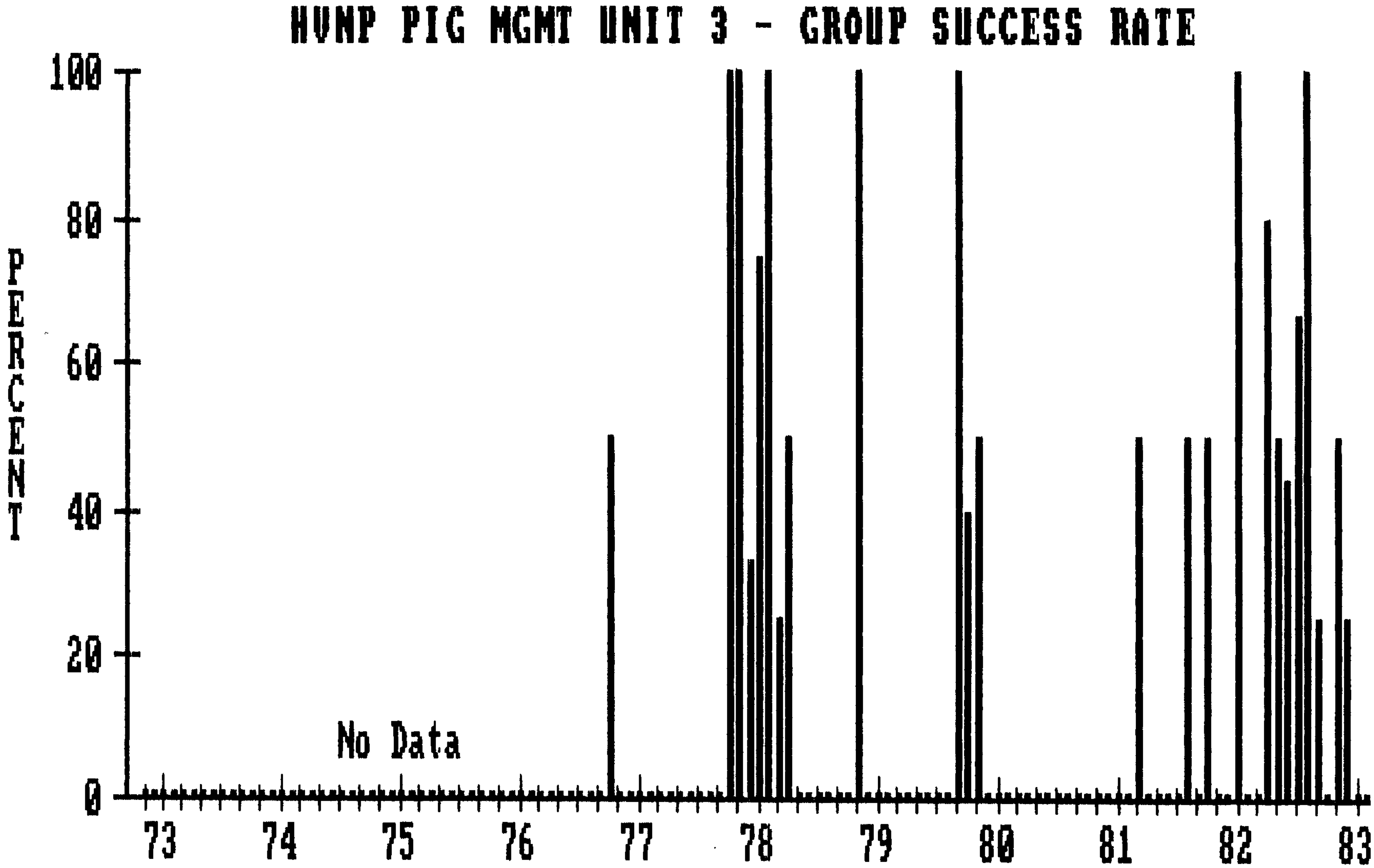
1.5
1.0
.5
0.0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 3 - GROUP SUCCESS RATE
PERCENT
100
80
60
40
20
0
No Data
73
74
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76
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78
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80
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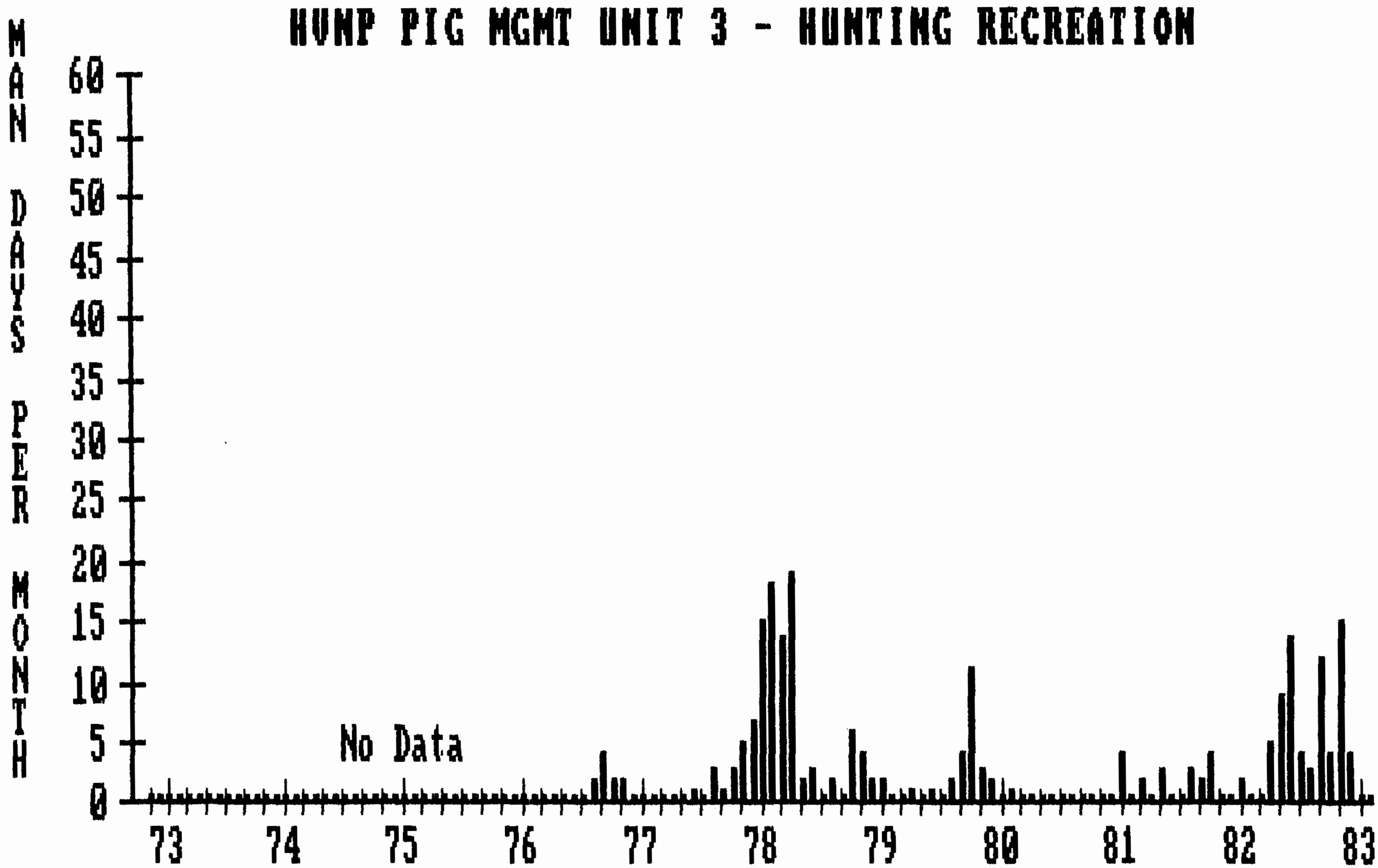
83



HVNP PIG MGMT UNIT 3 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
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No Data
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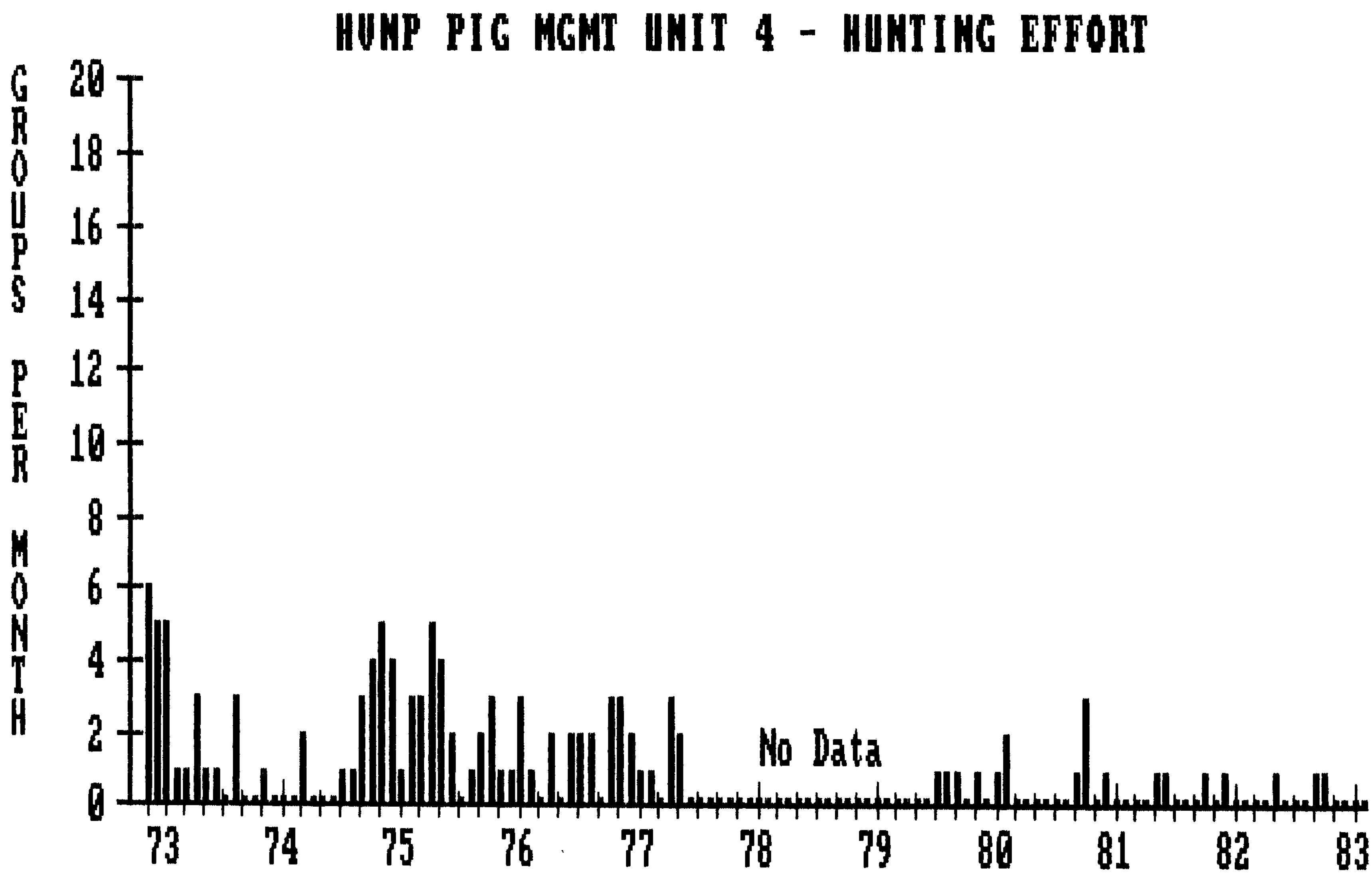
HVNP PIG MGMT UNIT 4 - HUNTING EFFORT
GROUPS PER MONTH
0
2
4
6
8
10
12
14
16
18
20
No Data
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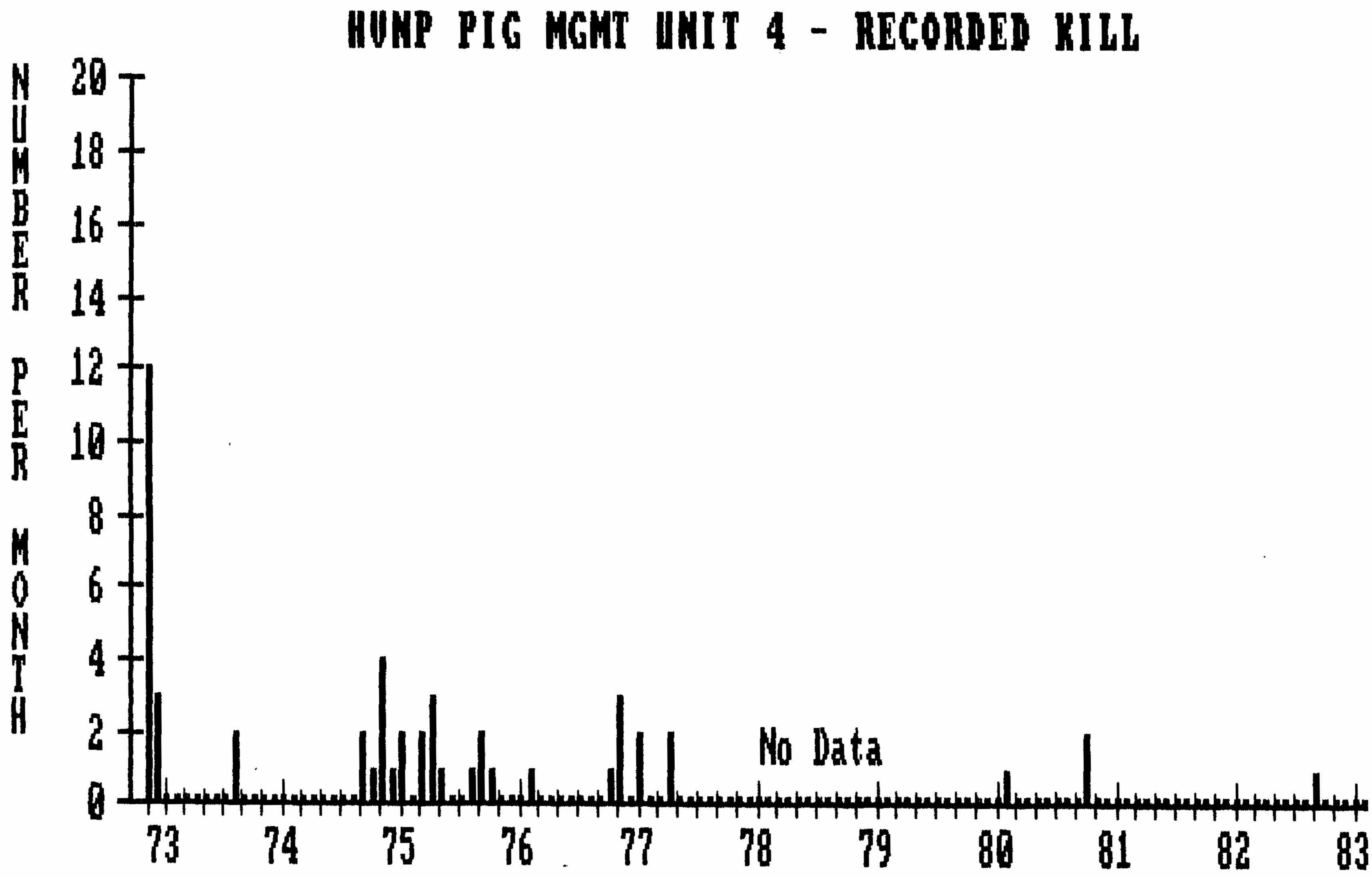
74
75
76
77
78
79
80
81
82
83



HVNP PIG MGMT UNIT 4 - RECORDED KILL
NUMBER PER MONTH
20
18
16
14
12
10
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6
4
2
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No Data
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74
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76
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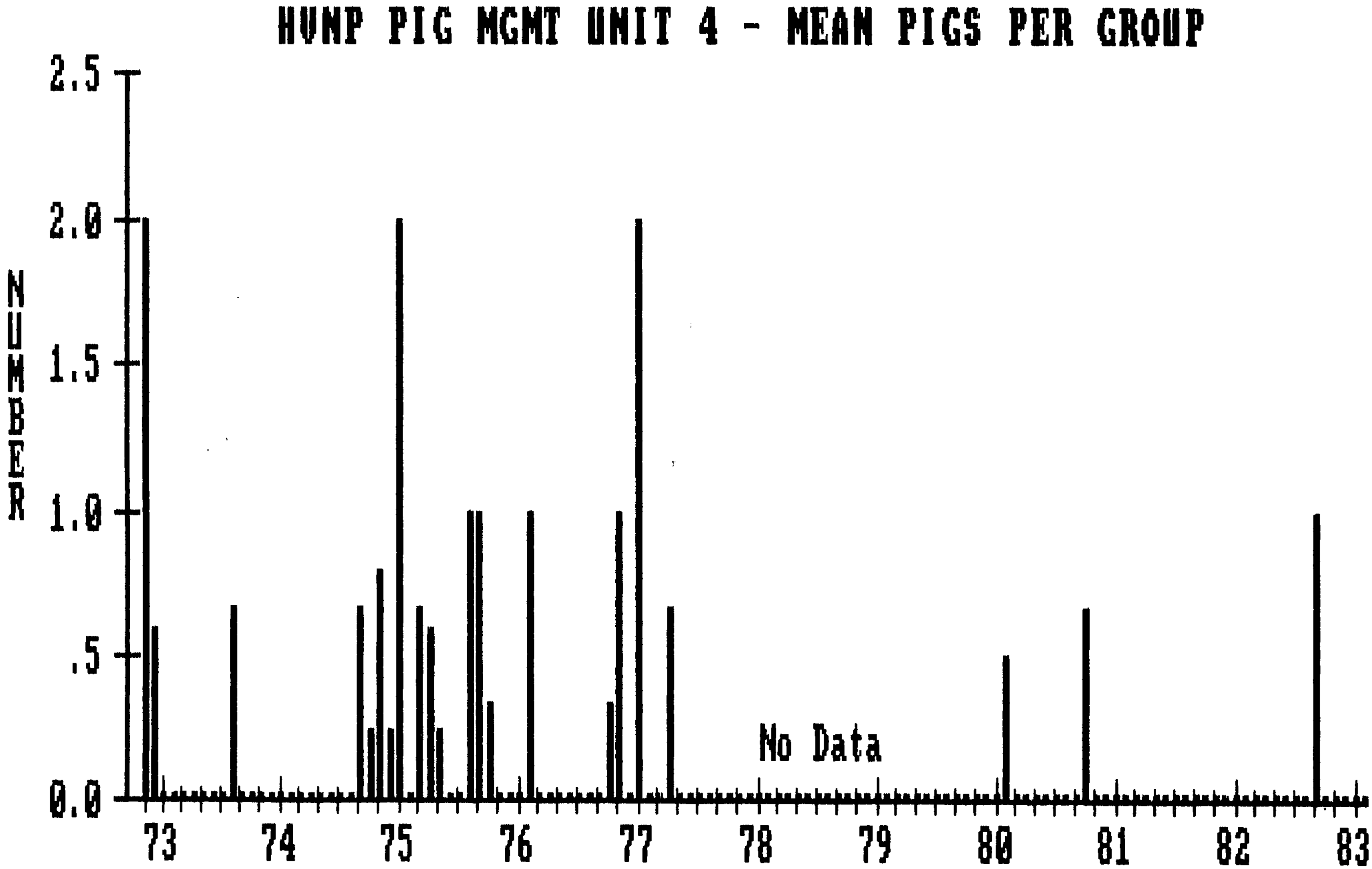
HVNP PIG MGMT UNIT 4 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
No Data
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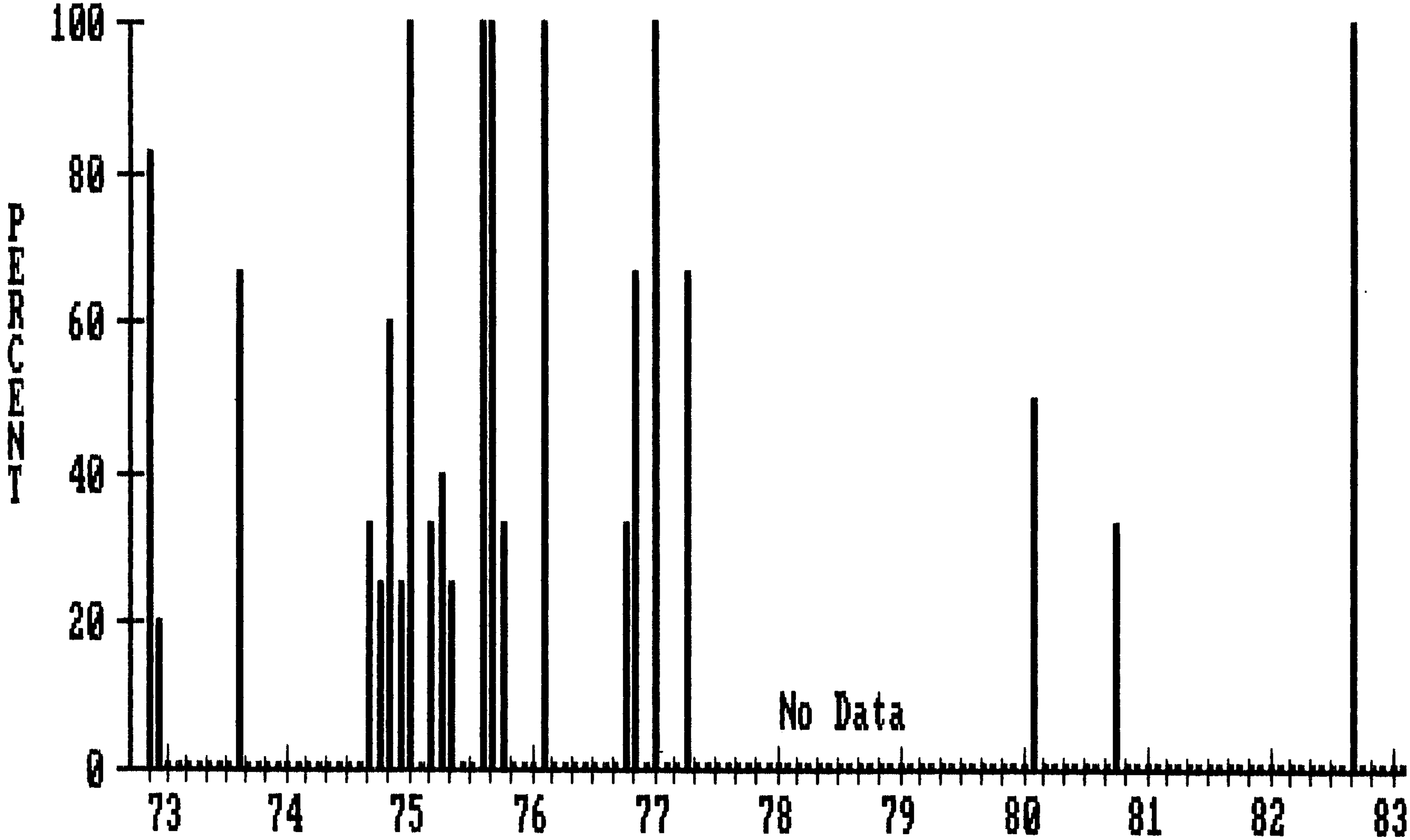
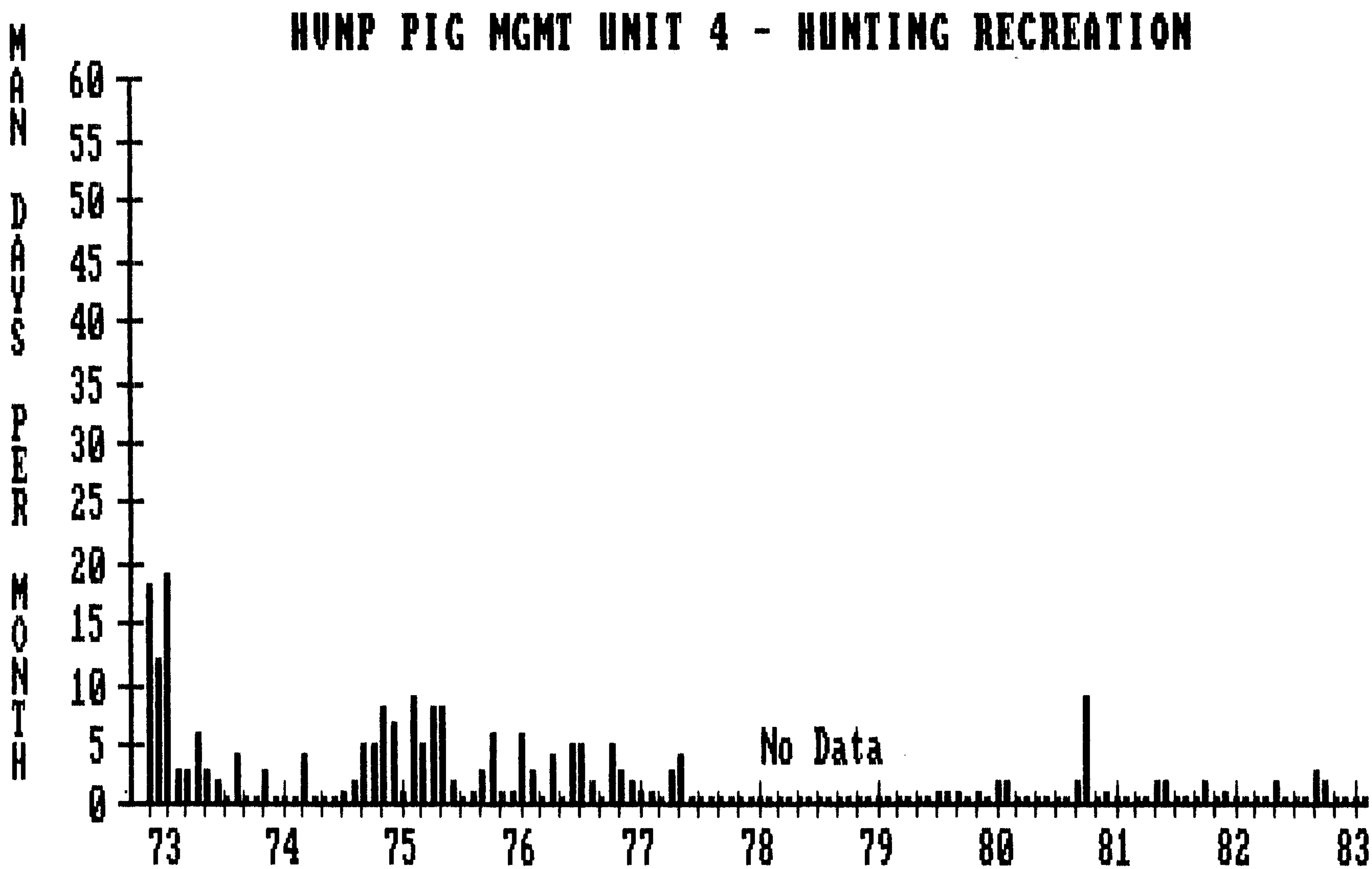
74
75
76
77
78
79
80
81
82
83

HVNP PIG MGMT UNIT 4 - GROUP SUCCESS RATE




HVNP PIG MGMT UNIT 4 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
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15
10
5
0
No Data
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74
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76
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80
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82
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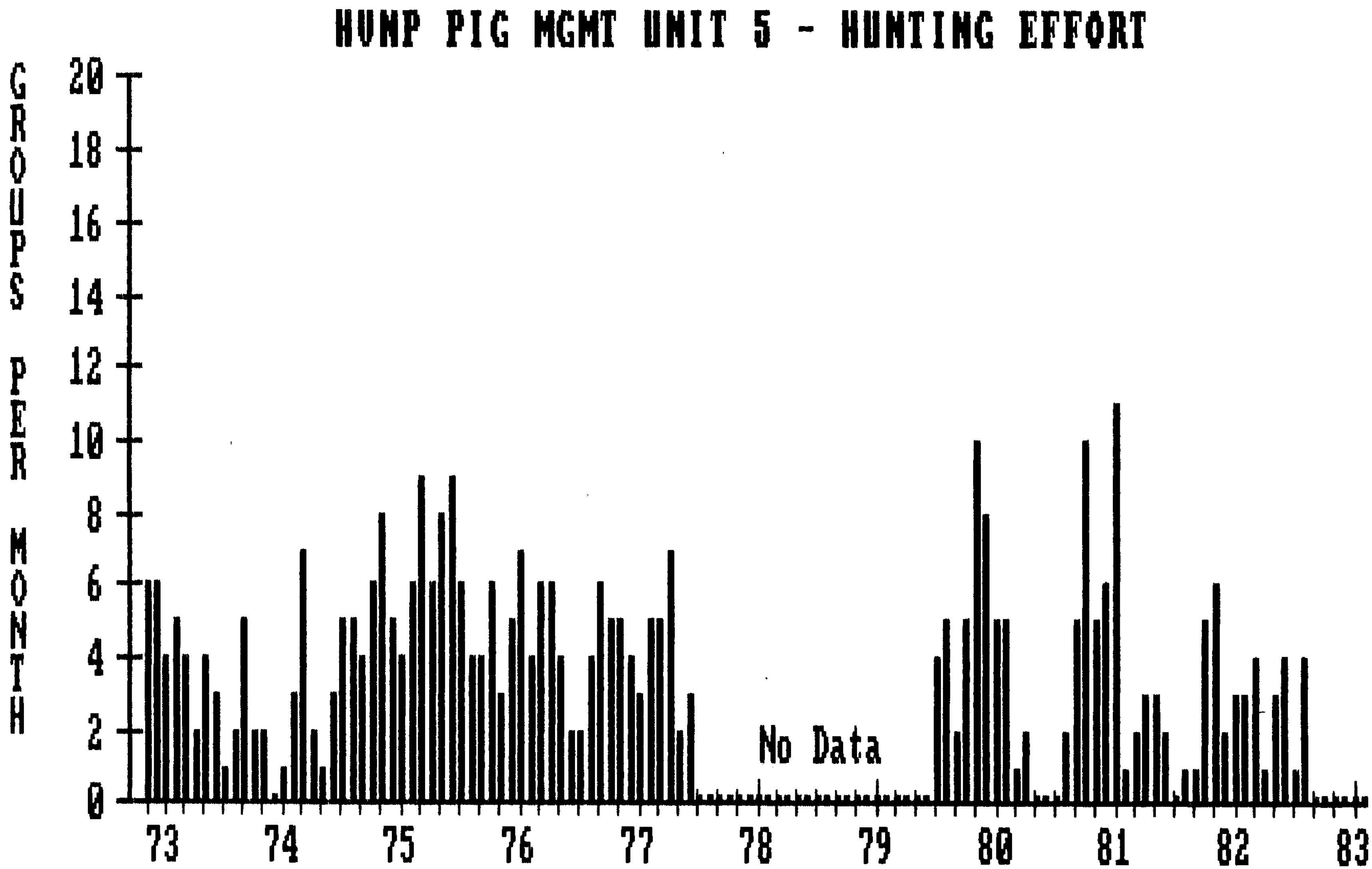
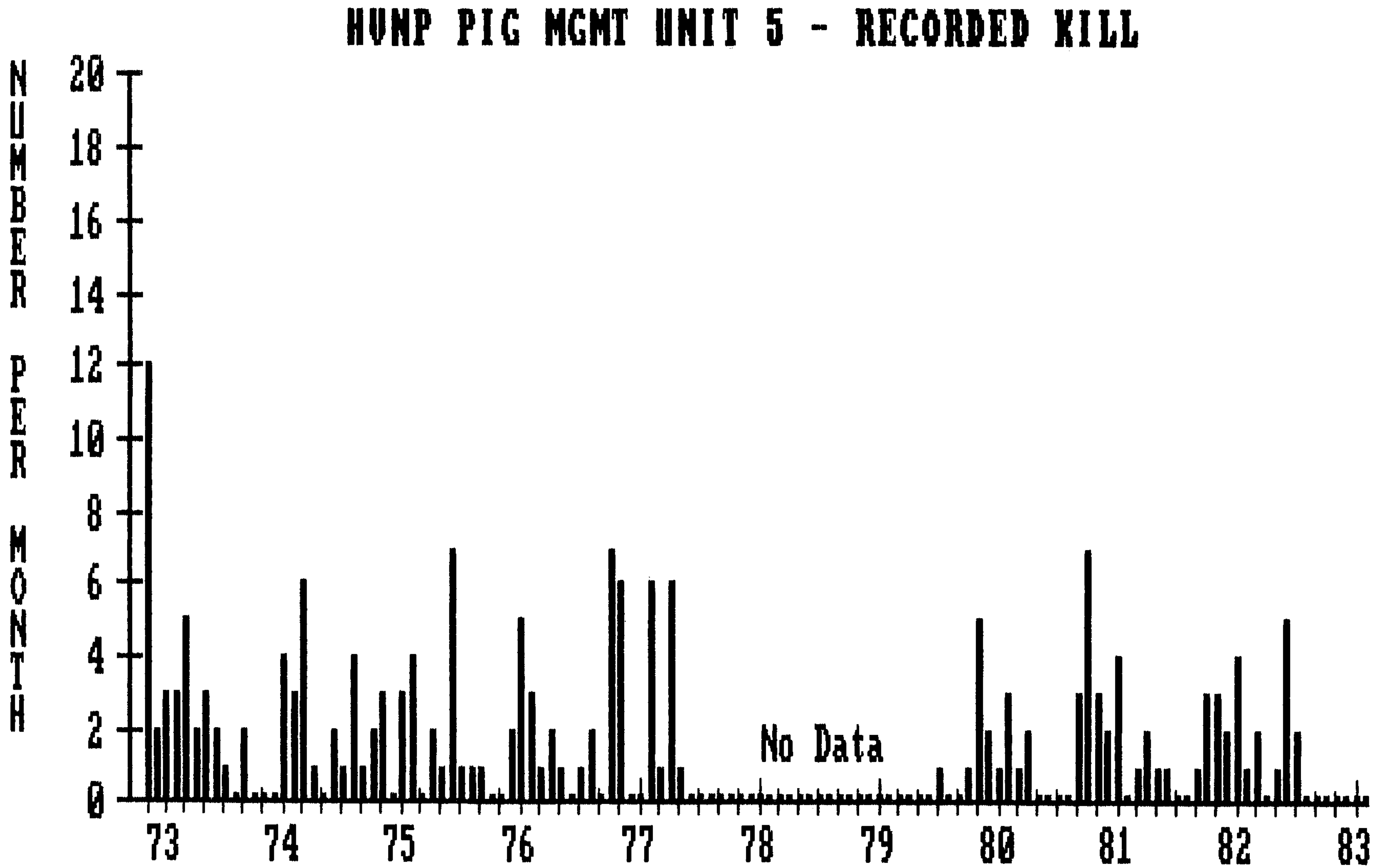
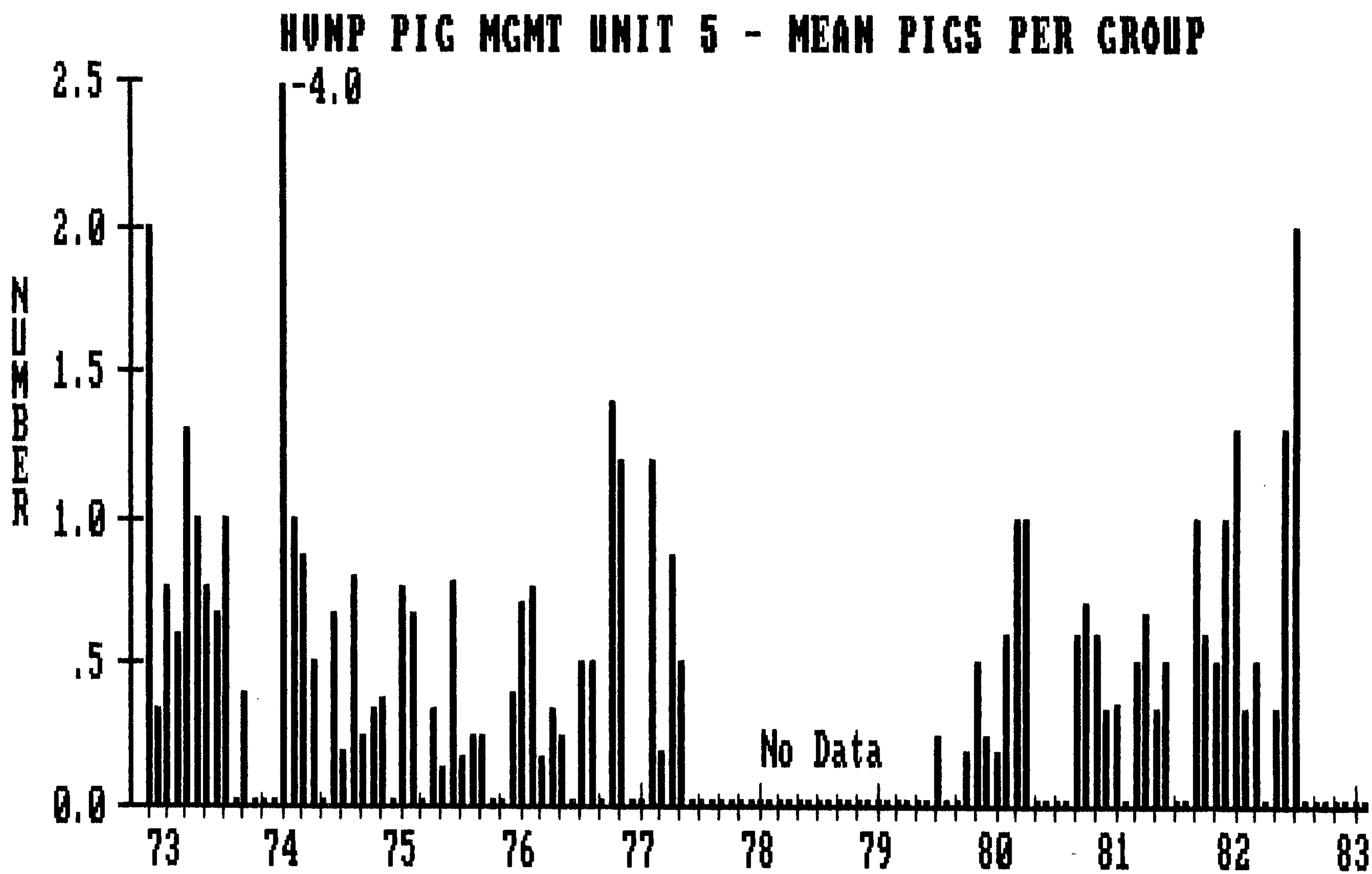
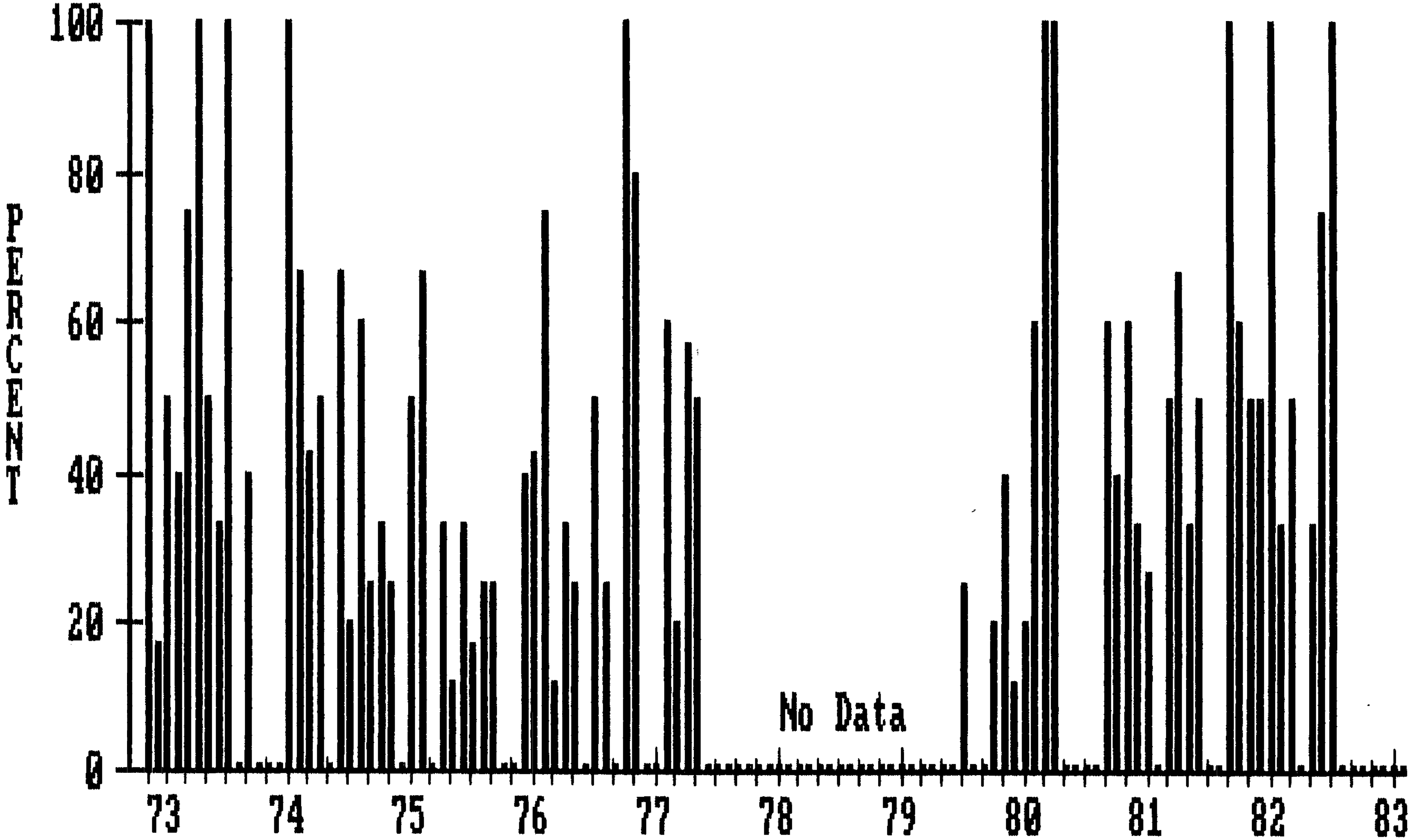

HUMP PIG MGMT UNIT 5 - HUNTING EFFORT
GROUPS PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
75
76
77
78
79
80
81
82
83

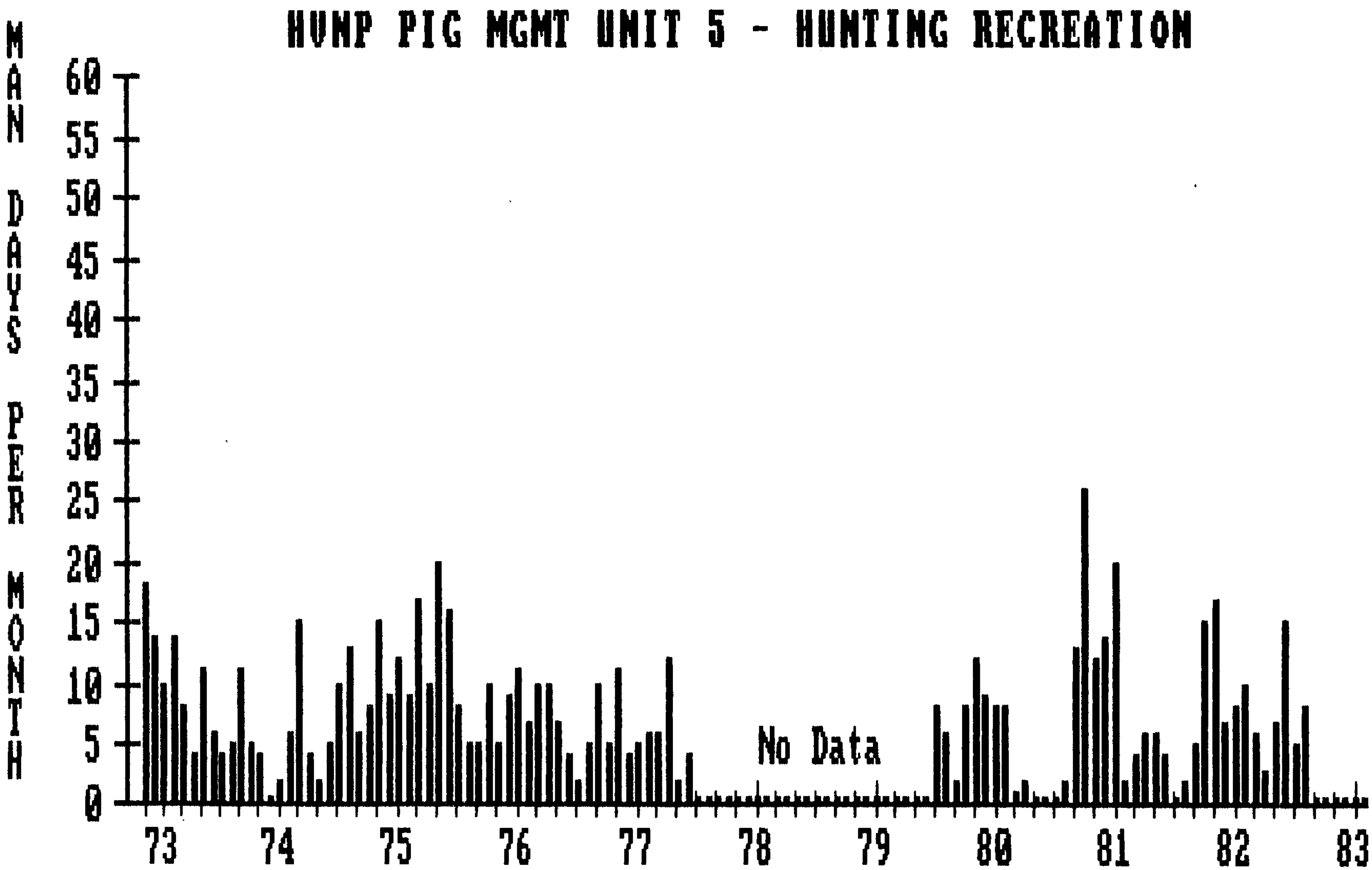


HVNP PIG MGMT UNIT 5 - RECORDED KILL
NUMBER PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
75
76
77
78
79
80
81
82
83

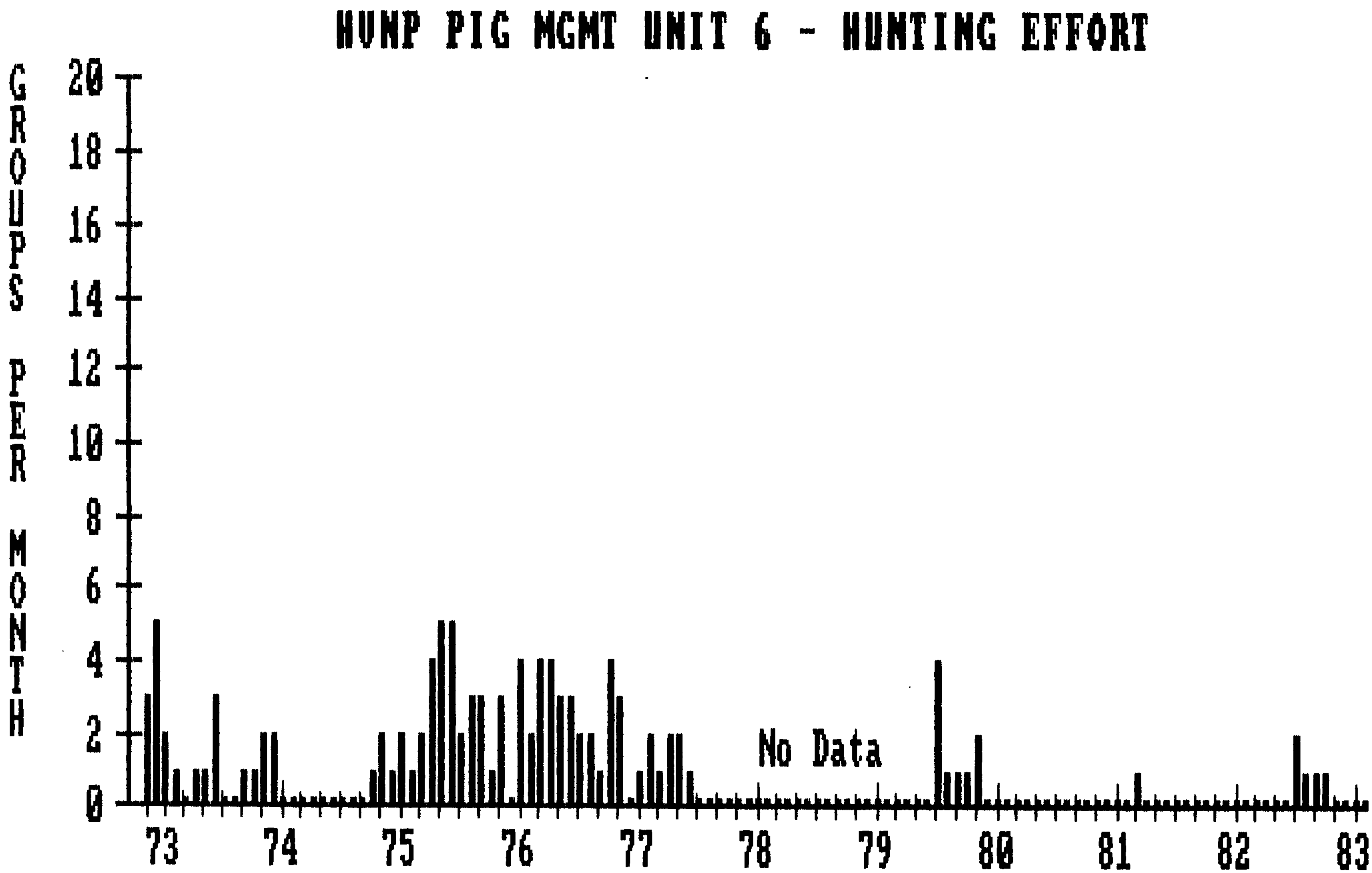

HVNP PIG MGMT UNIT 5 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
-4.0
No Data
73
74
75
76
77
78
79
80
81
82
83

HUMP PIG MGMT UNIT 5 - GROUP SUCCESS RATE

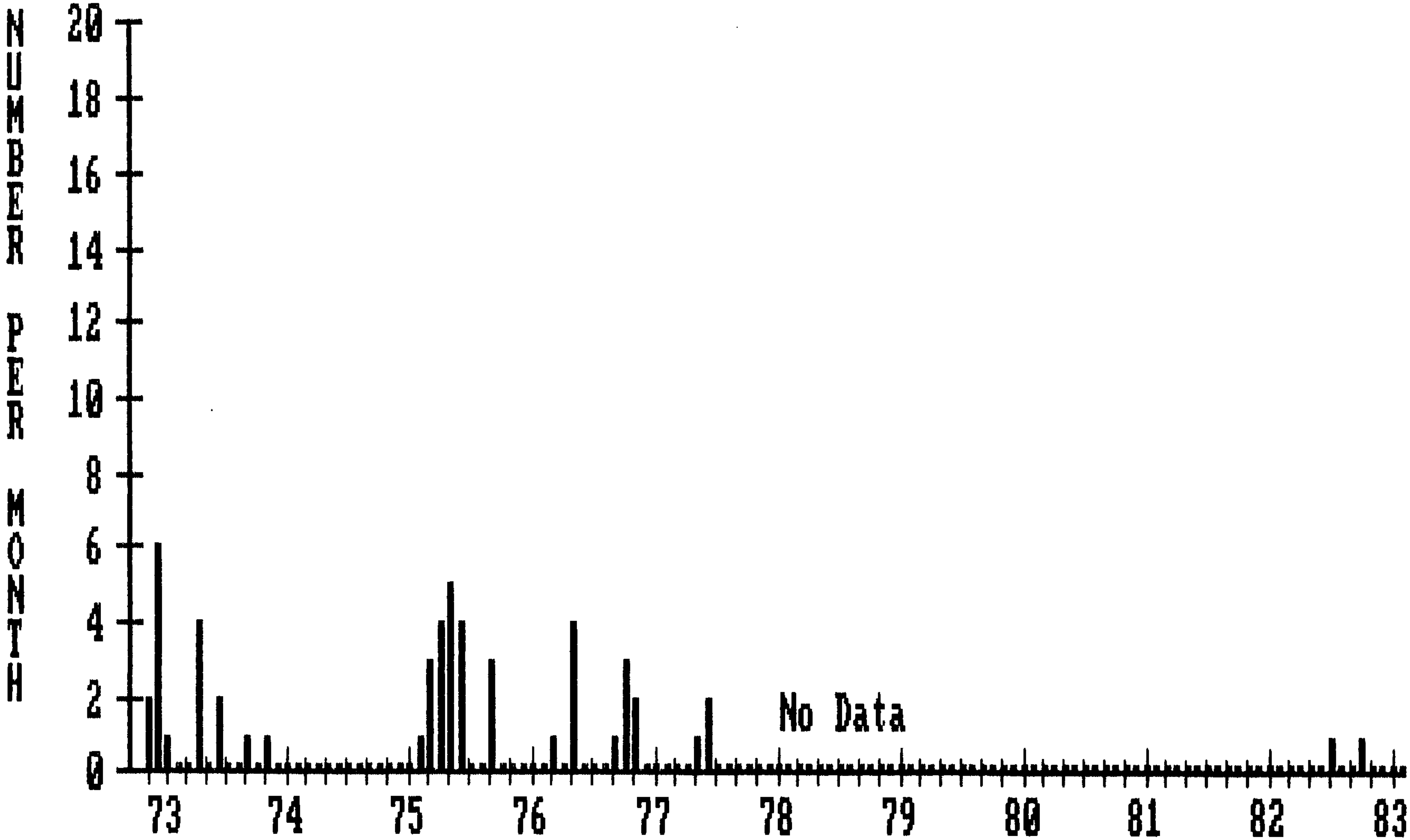


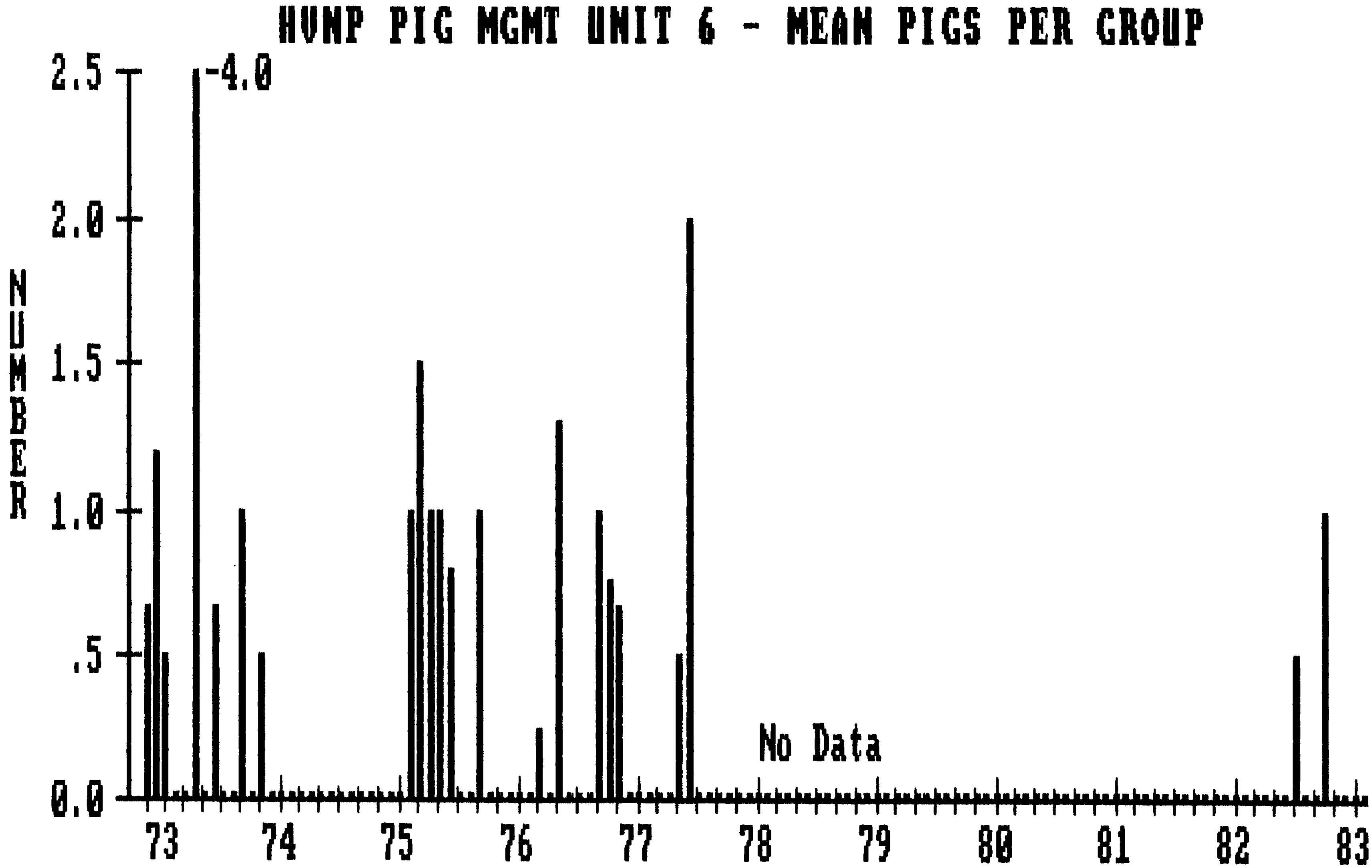


HVNP PIG MGMT UNIT 5 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83


HVNP PIG MGMT UNIT 6 - HUNTING EFFORT
GROUPS PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
75
76
77
78
79
80
81
82
83

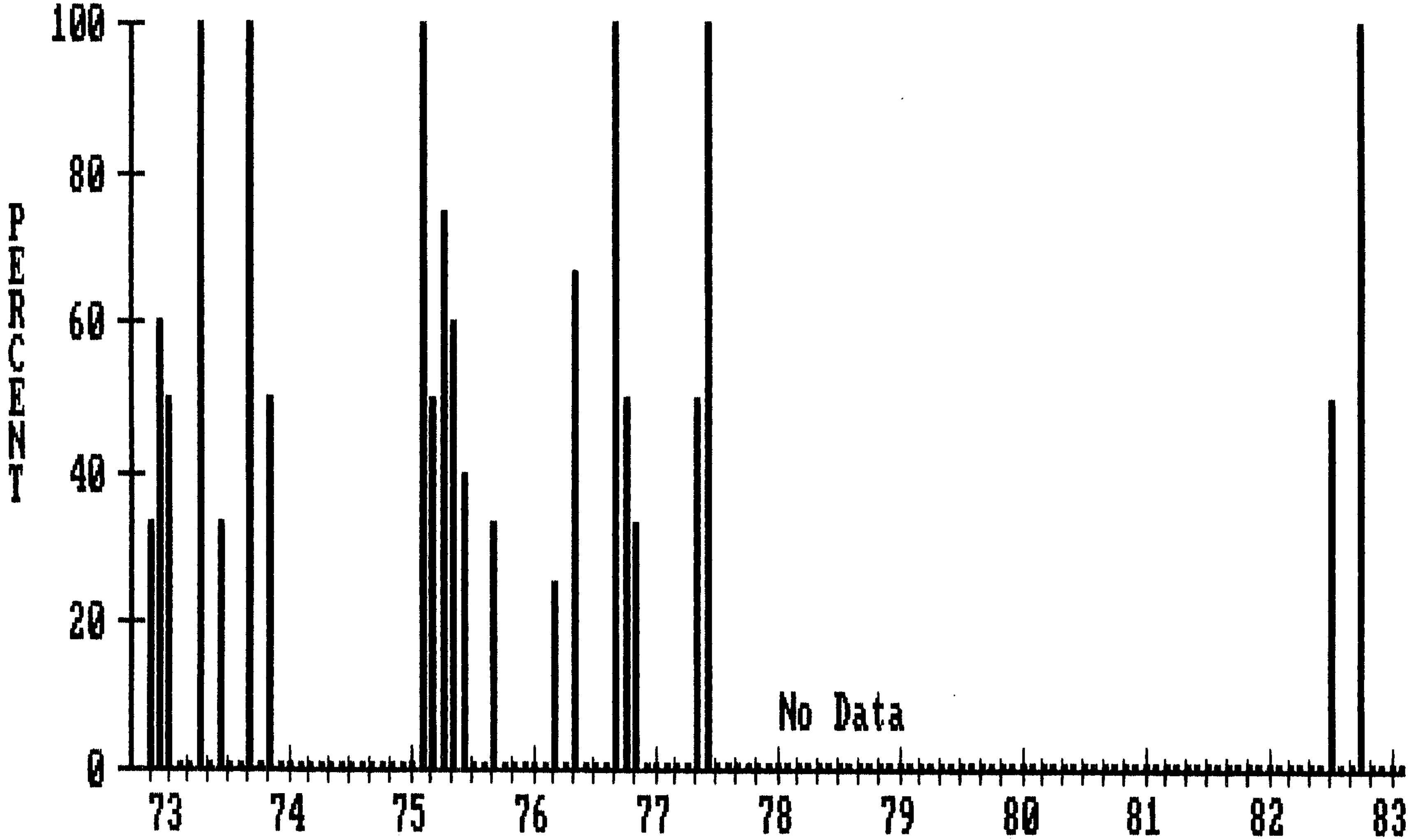
HUNP PIG MGMT UNIT 6 - RECORDED KILL

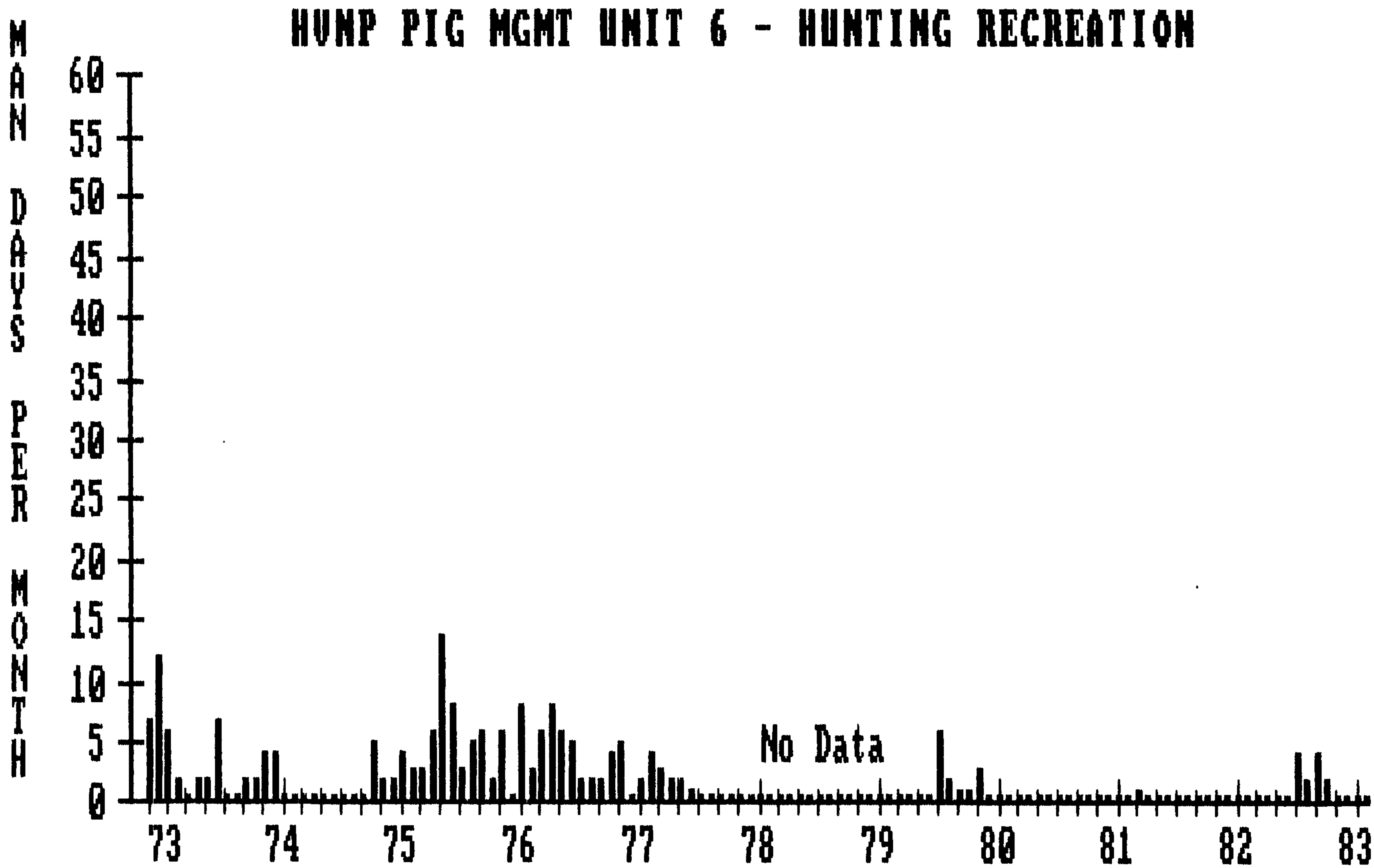




HVNP PIG MGMT UNIT 6 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
-4.0
No Data
73
74
75
76
77
78
79
80
81
82
83

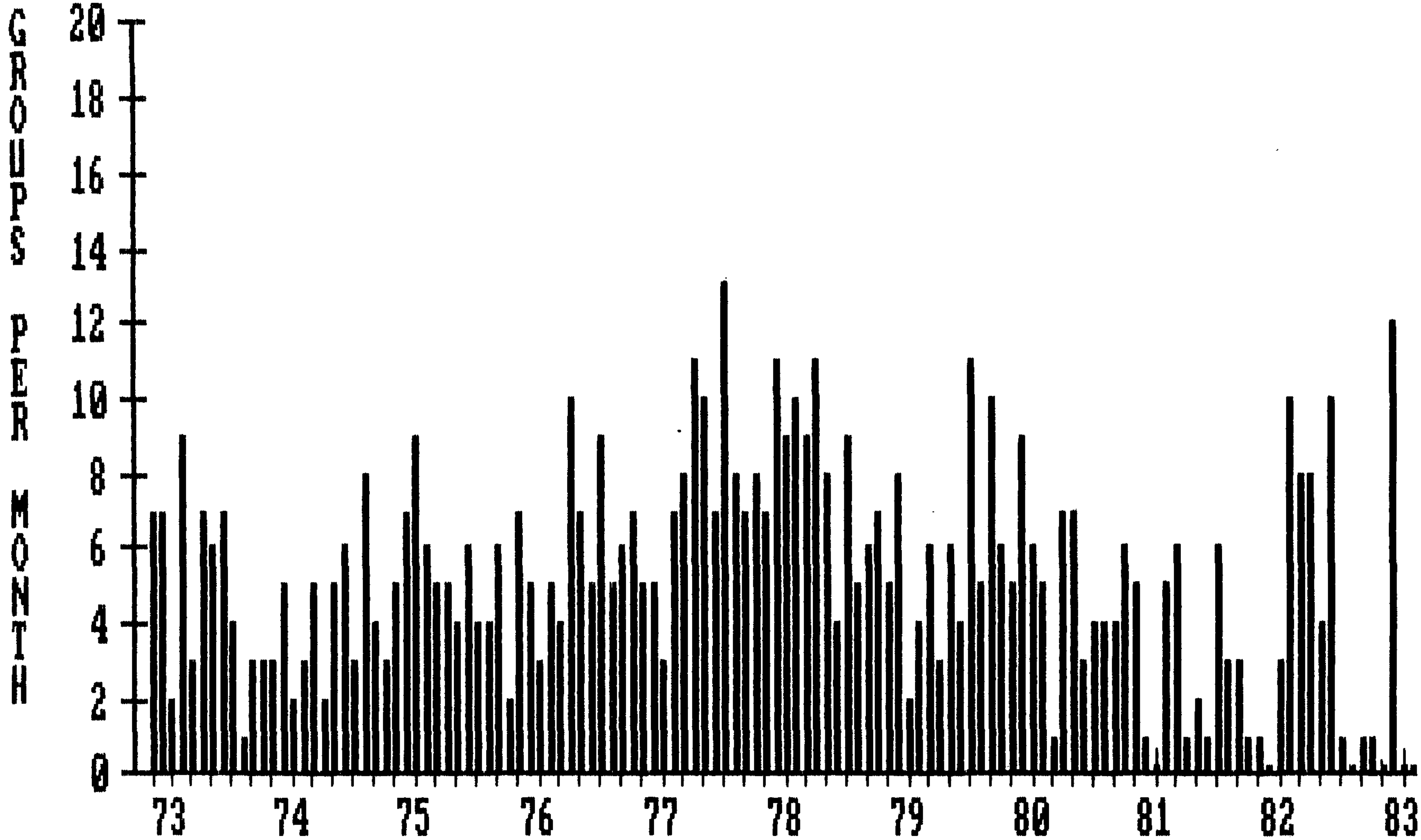
HUMP PIG MGMT UNIT 6 - GROUP SUCCESS RATE



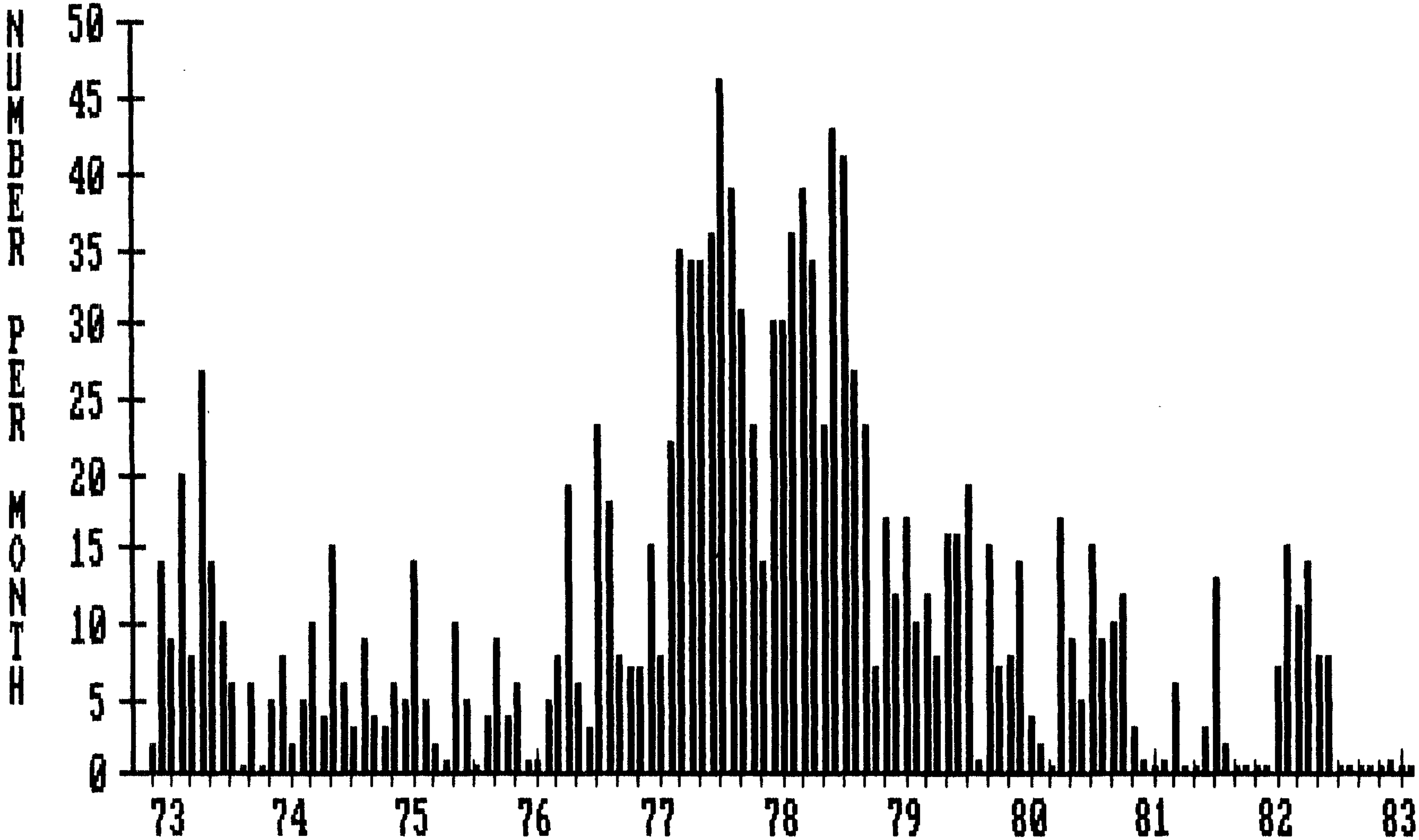


HVNP PIG MGMT UNIT 6 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83

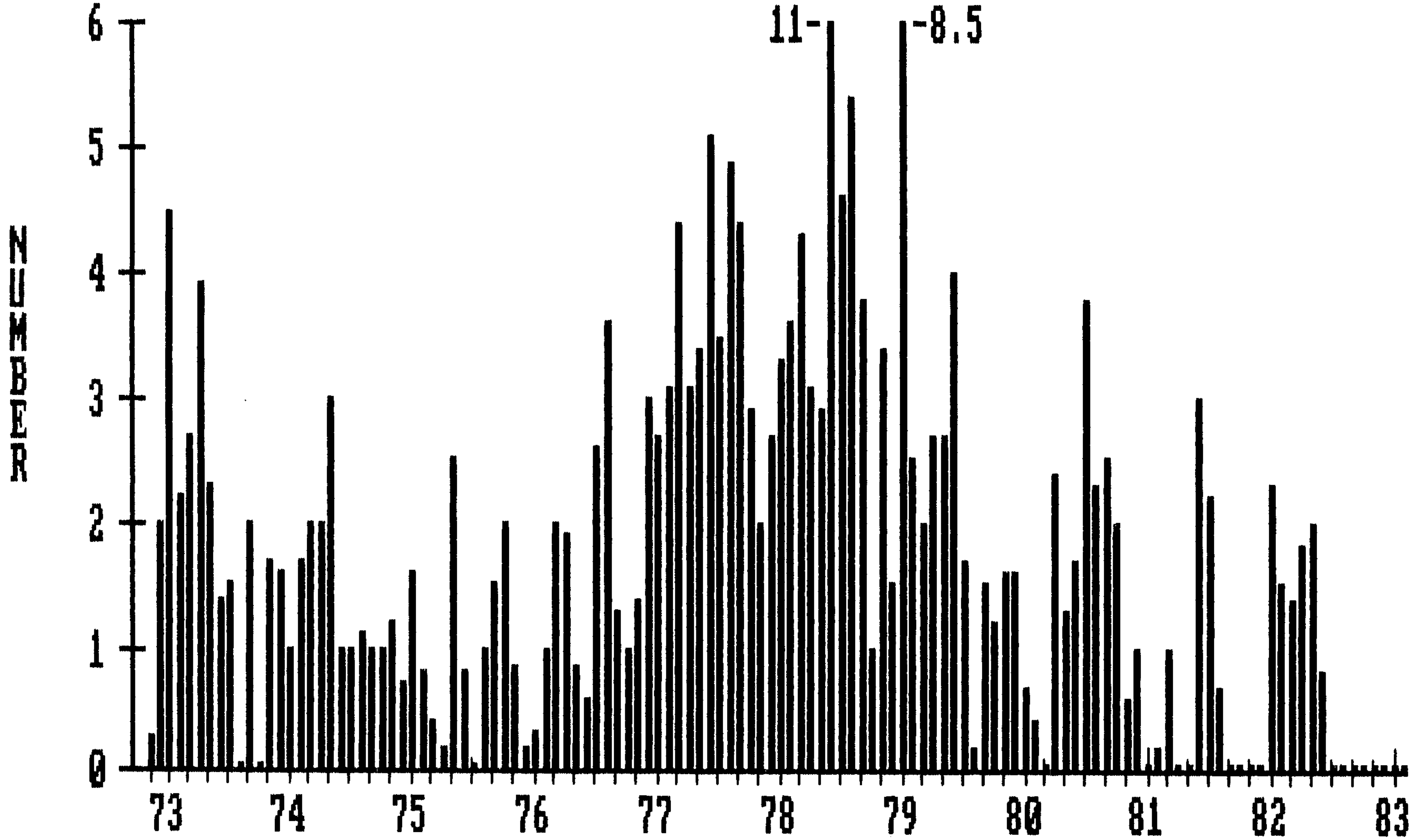
HVNP PIG MGMT UNIT 7 - HUNTING EFFORT

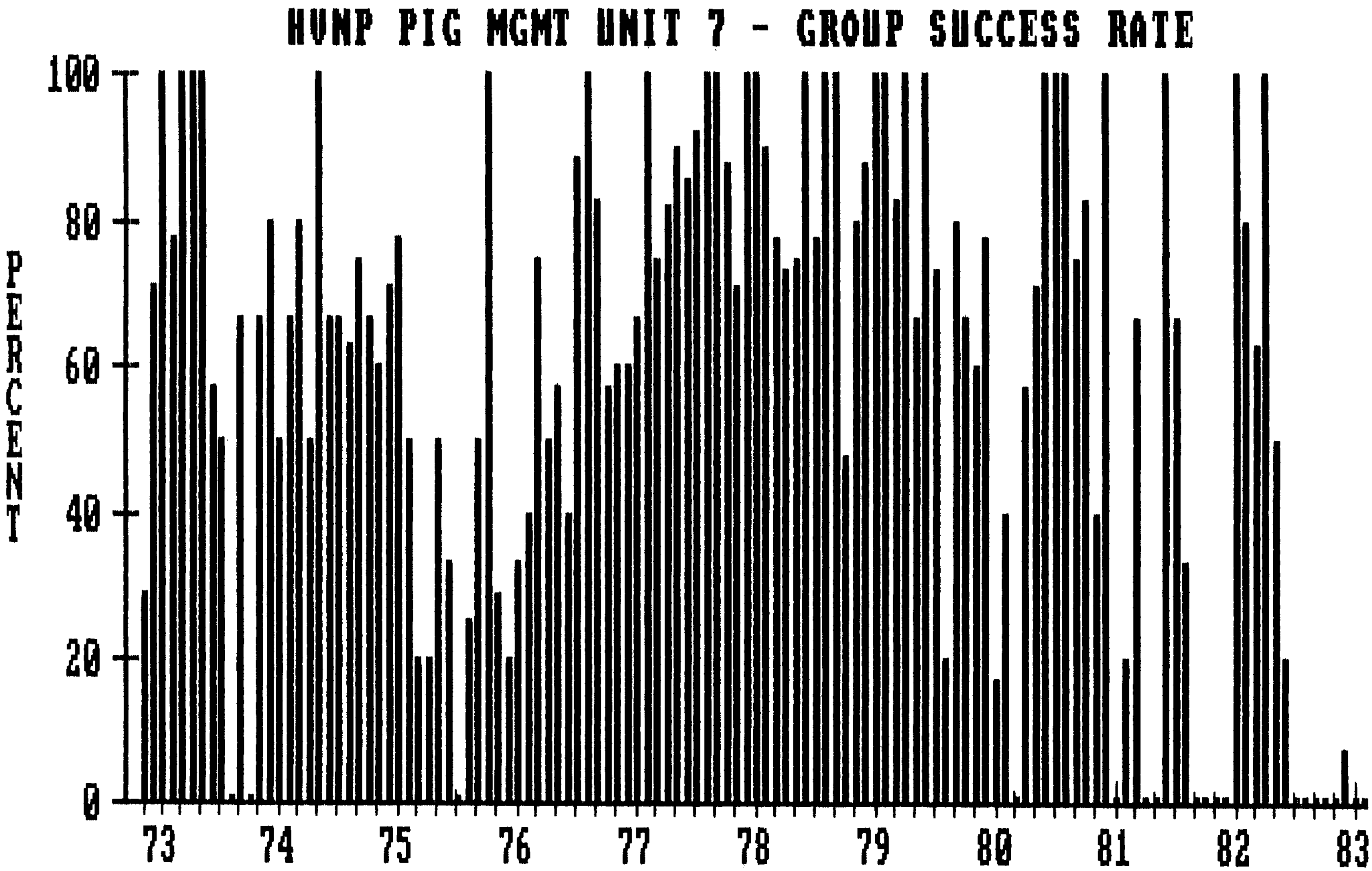


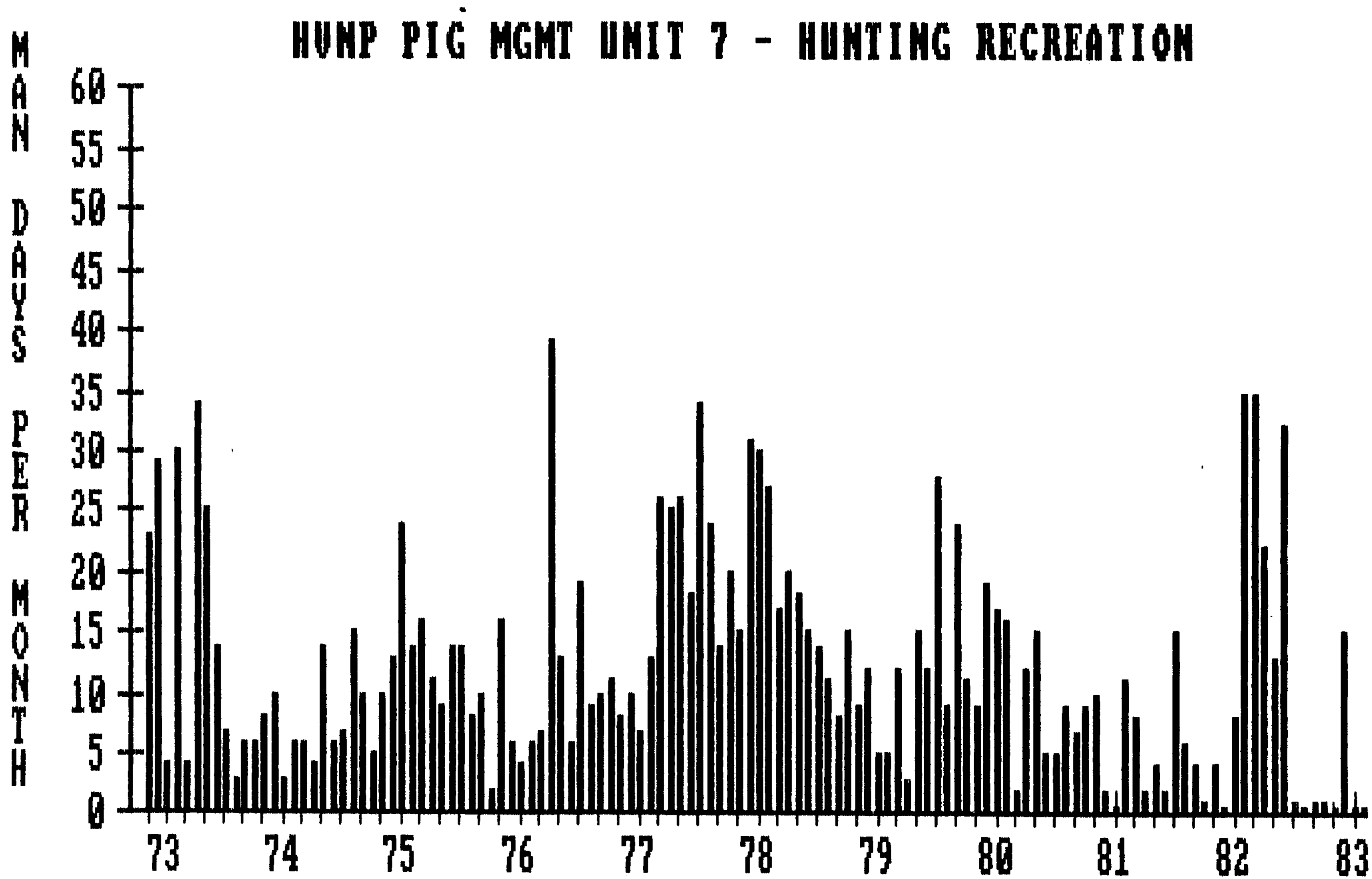
HUMP PIG MGMT UNIT 7 - RECORDED KILL



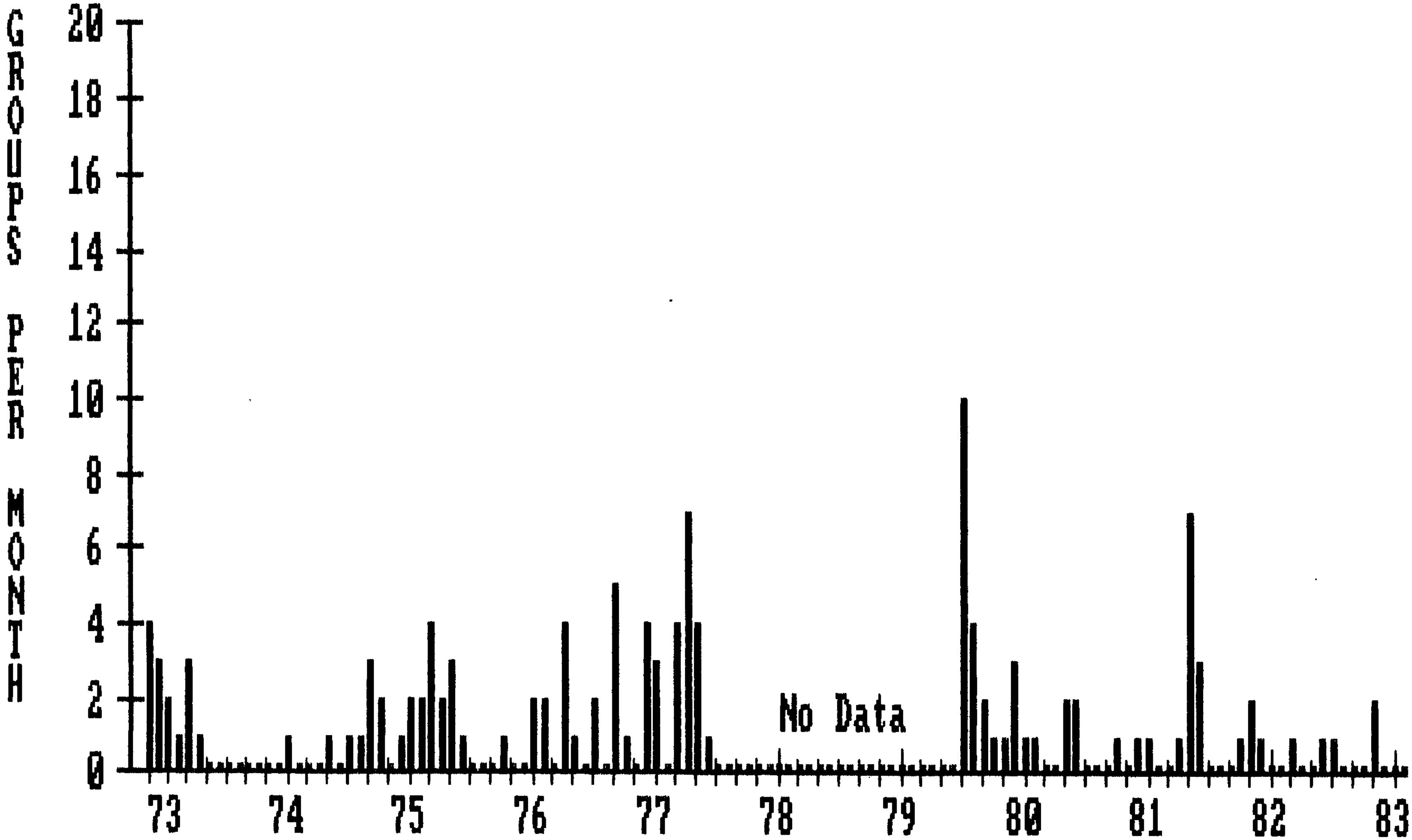
HVNP PIG MGMT UNIT 7 - MEAN PIGS PER GROUP

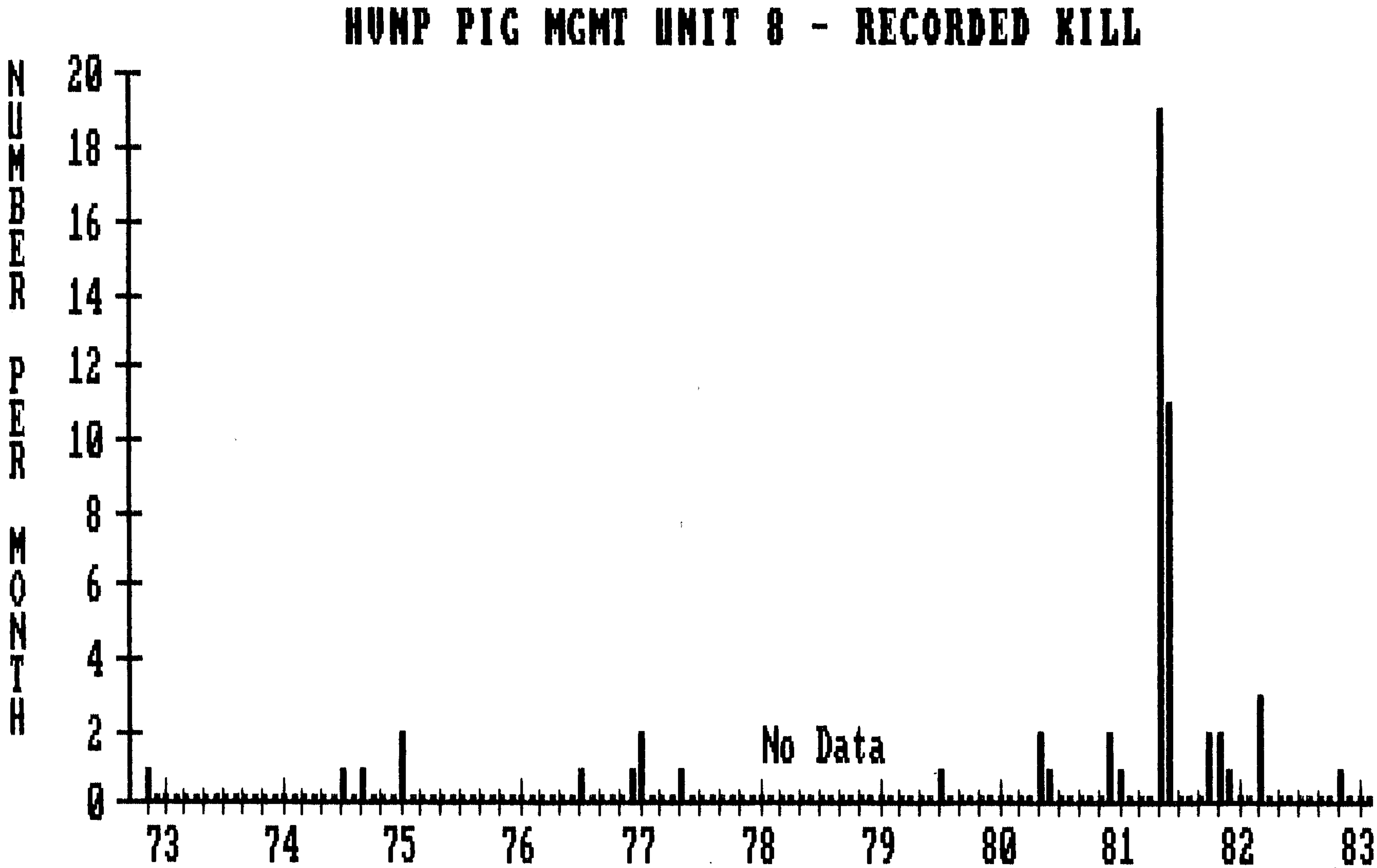



HVNP PIG MGMT UNIT 7 - GROUP SUCCESS RATE
PERCENT
100
80
60
40
20
0
73
74
75
76
77
78
79
80
81
82
83


HUNP PIG MGMT UNIT 7 - HUNTING RECREATION
MAN DAYS PER MONTH
0
5
10
15
20
25
30
35
40
45
50
55
60
73
74
75
76
77
78
79
80
81
82
83

HVNP PIG MGMT UNIT 8 - HUNTING EFFORT




HUMP PIG MGMT UNIT 8 - RECORDED KILL
NUMBER PER MONTH
0
2
4
6
8
10
12
14
16
18
20
No Data
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74
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76
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80
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82
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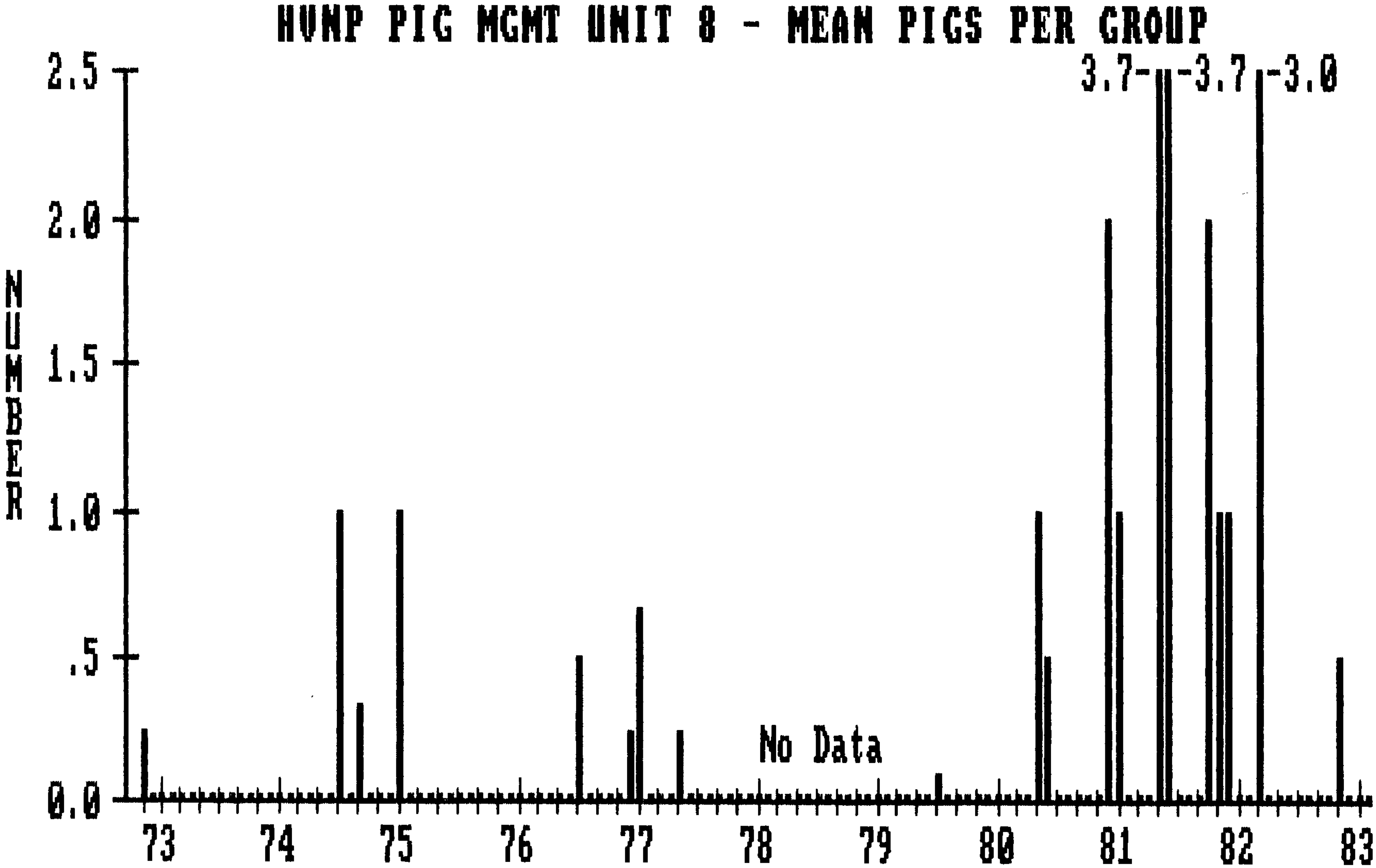
HVNP PIG MGMT UNIT 8 - MEAN PIGS PER GROUP
NUMBER
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1.5
1.0
.5
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3.7-
-3.7
-3.0
No Data
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74
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76
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80
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82
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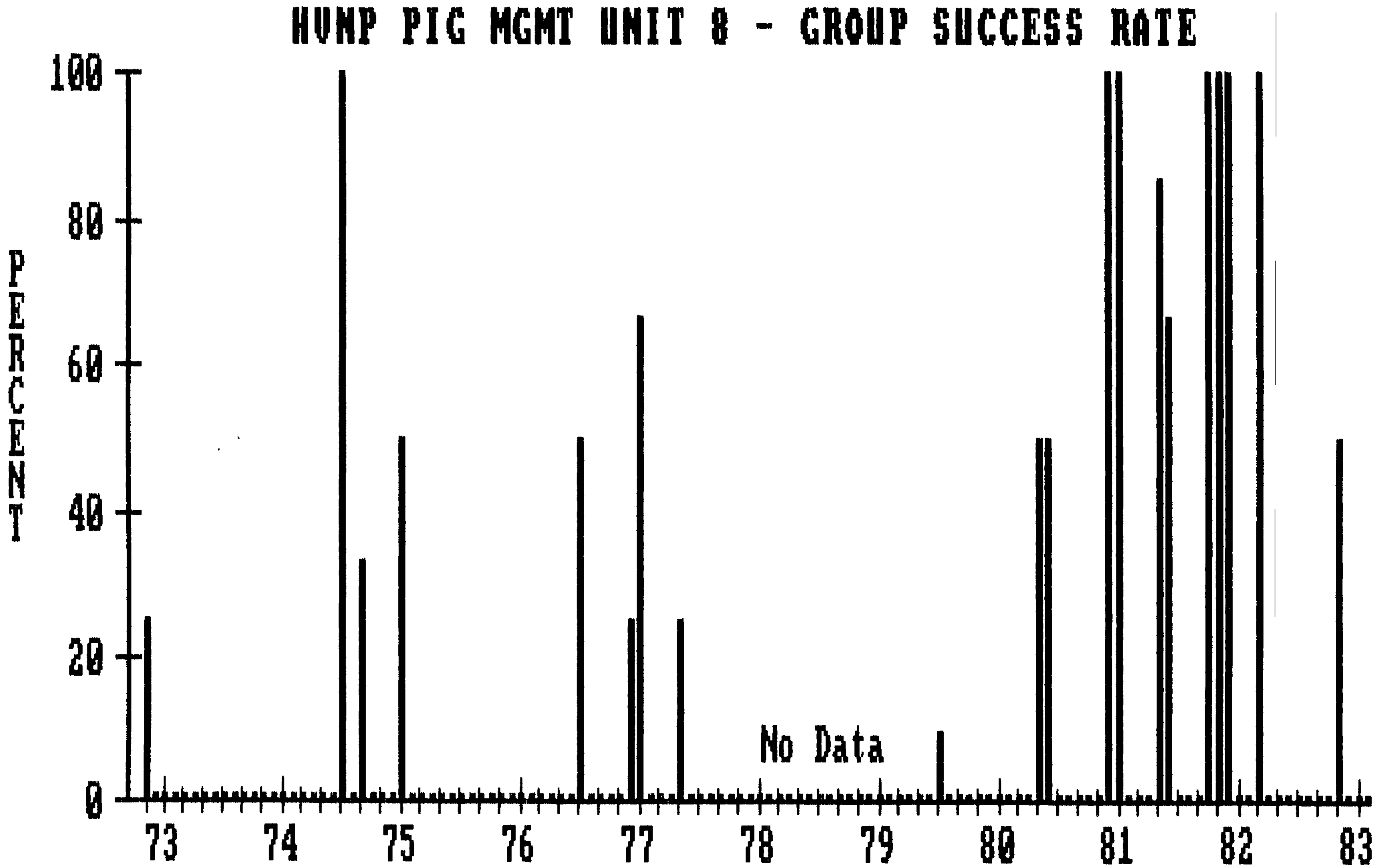

HUMP PIG MGMT UNIT 8 - GROUP SUCCESS RATE
PERCENT
100
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60
40
20
0
No Data
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74
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76
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80
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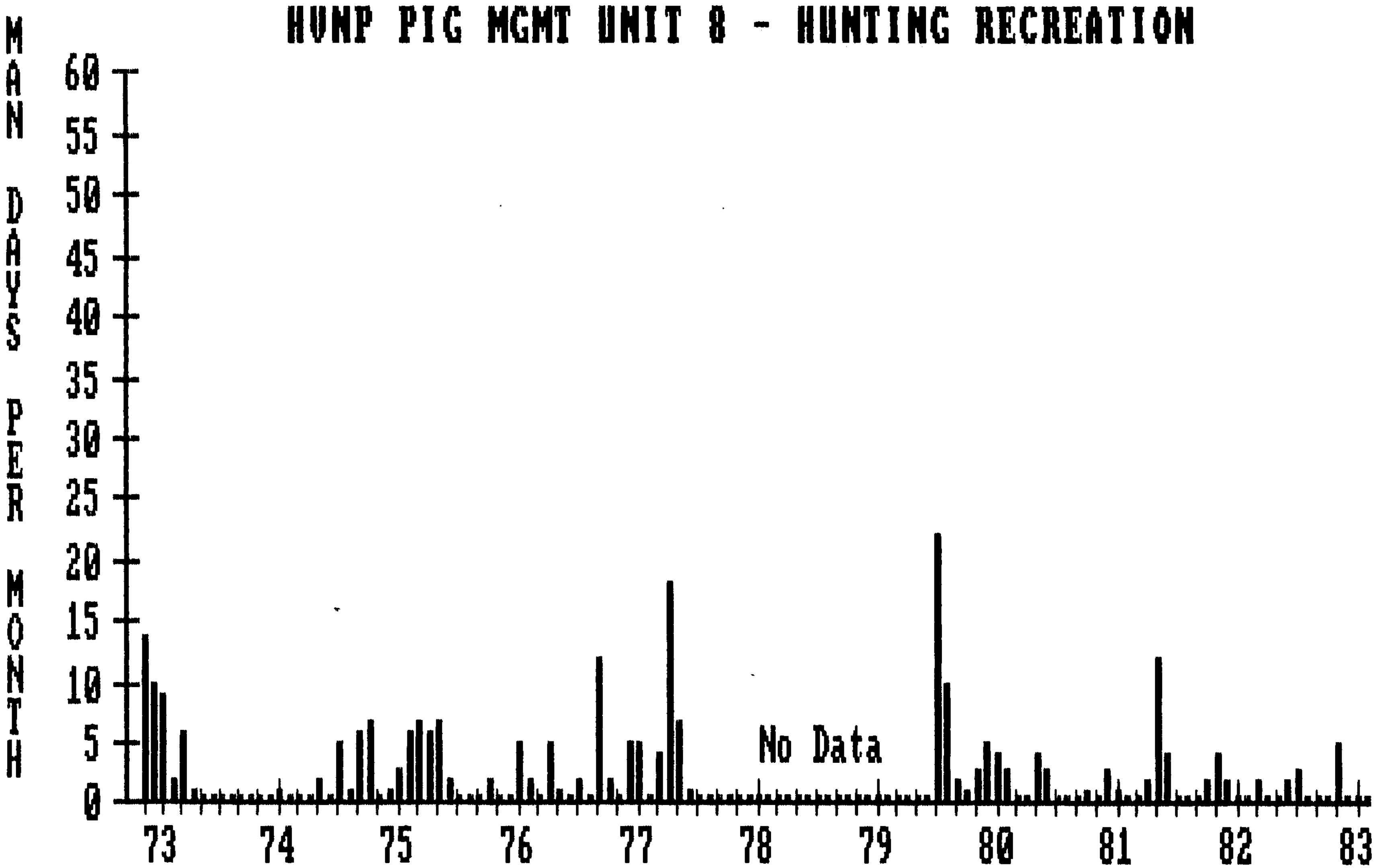
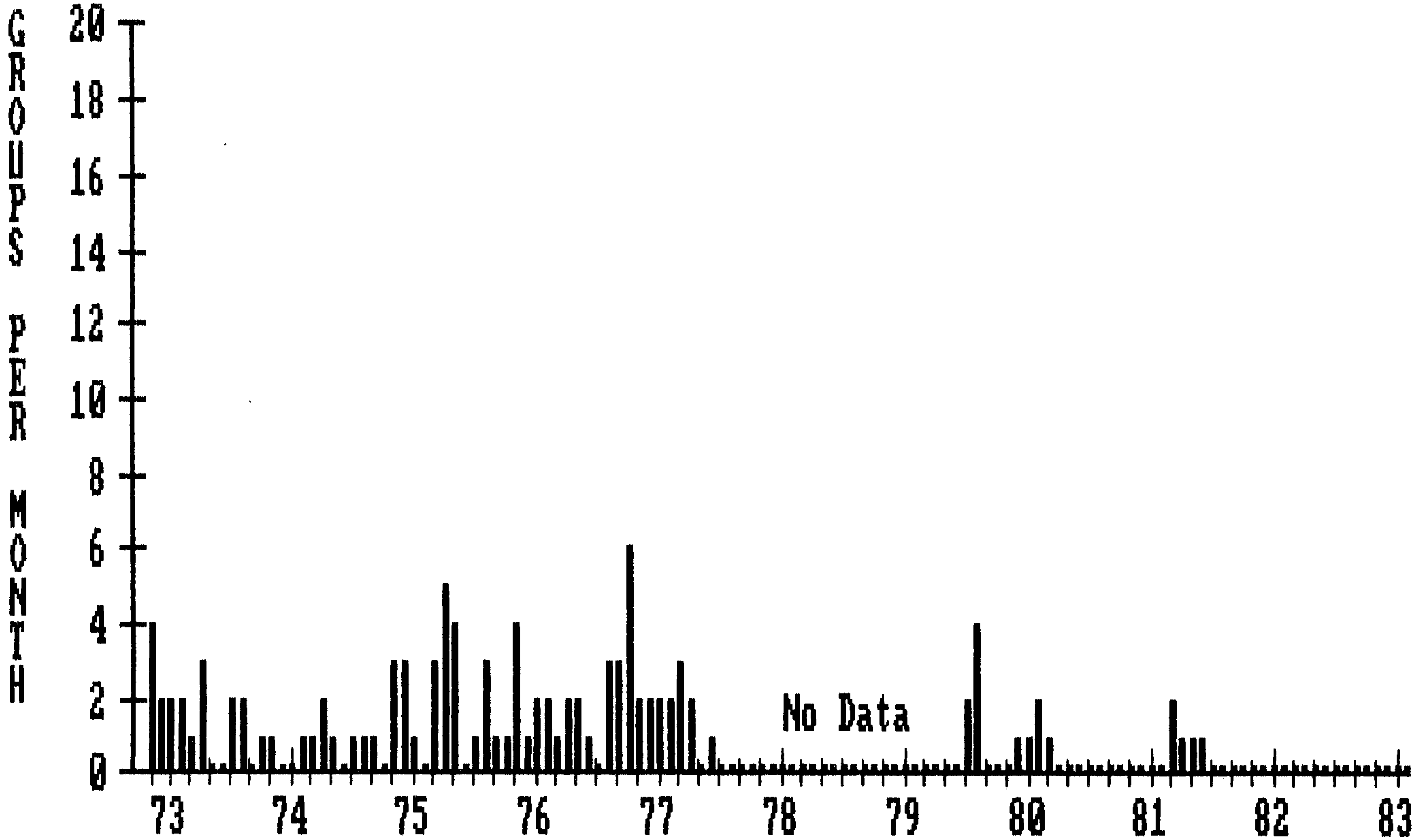
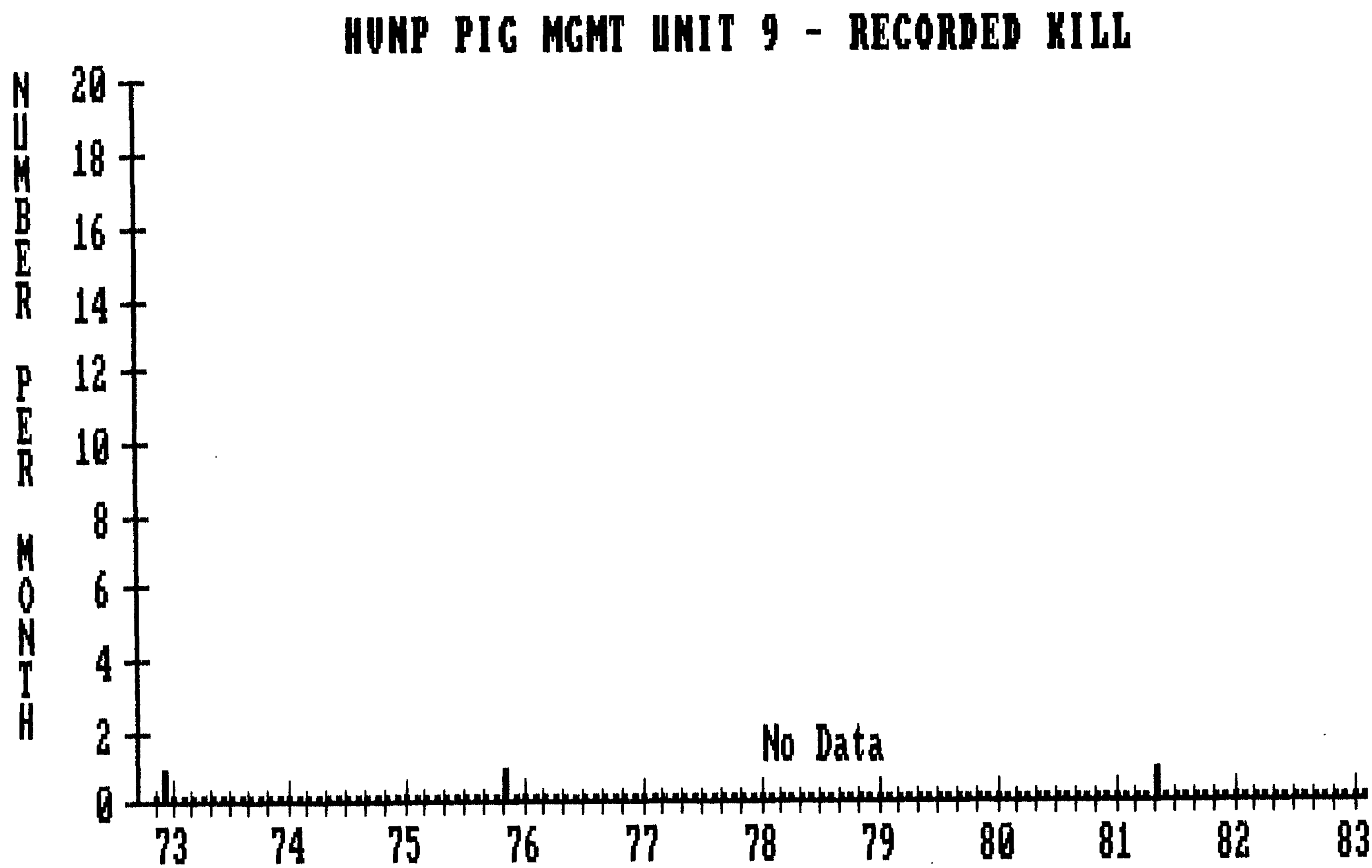
82
83



HVNP PIG MGMT UNIT 8 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83

HVNP PIG MGMT UNIT 9 - HUNTING EFFORT




HVNP PIG MGMT UNIT 9 - RECORDED KILL
NUMBER PER MONTH
20
18
16
14
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10
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6
4
2
0
No Data
73
74
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76
77
78
79
80
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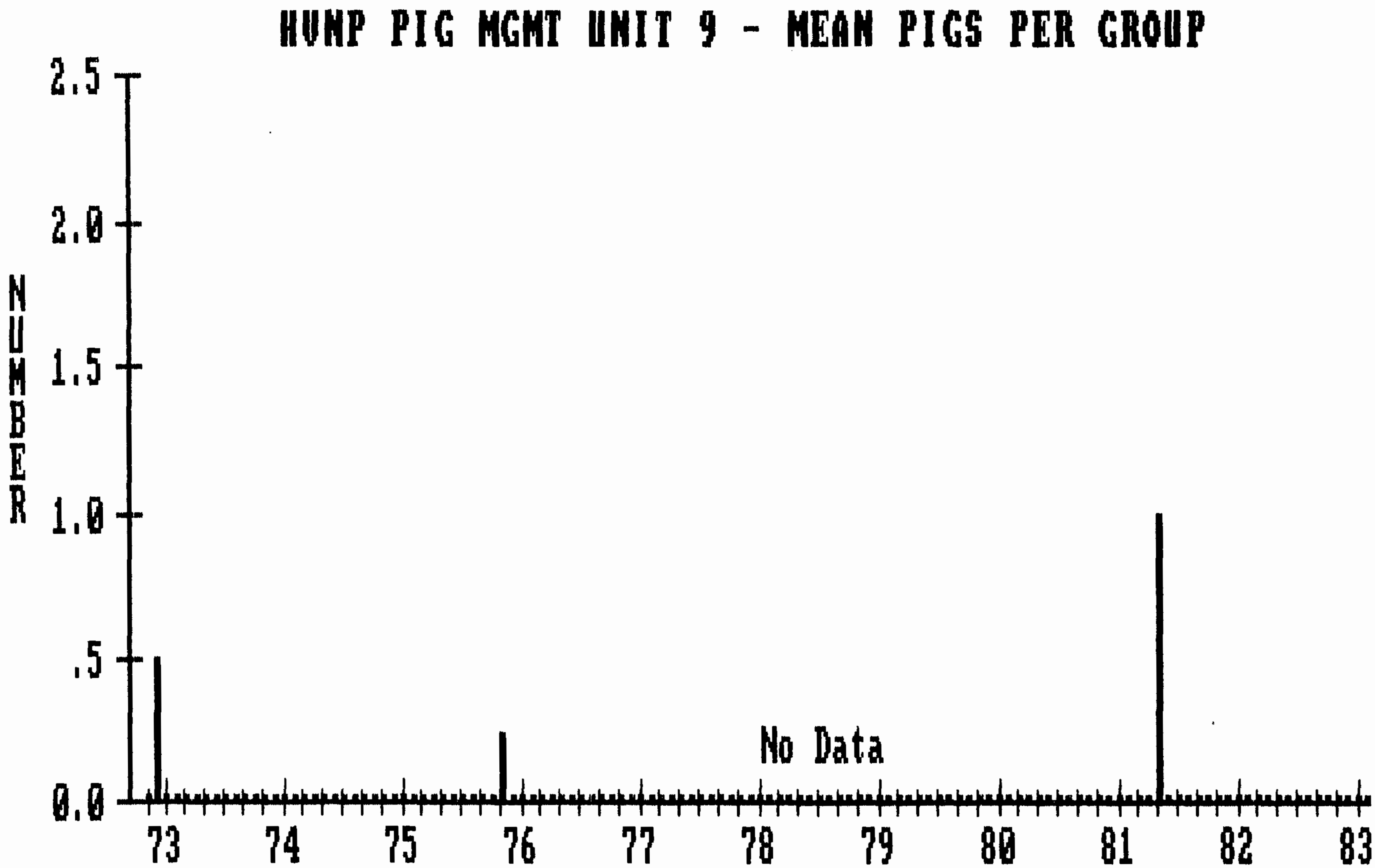
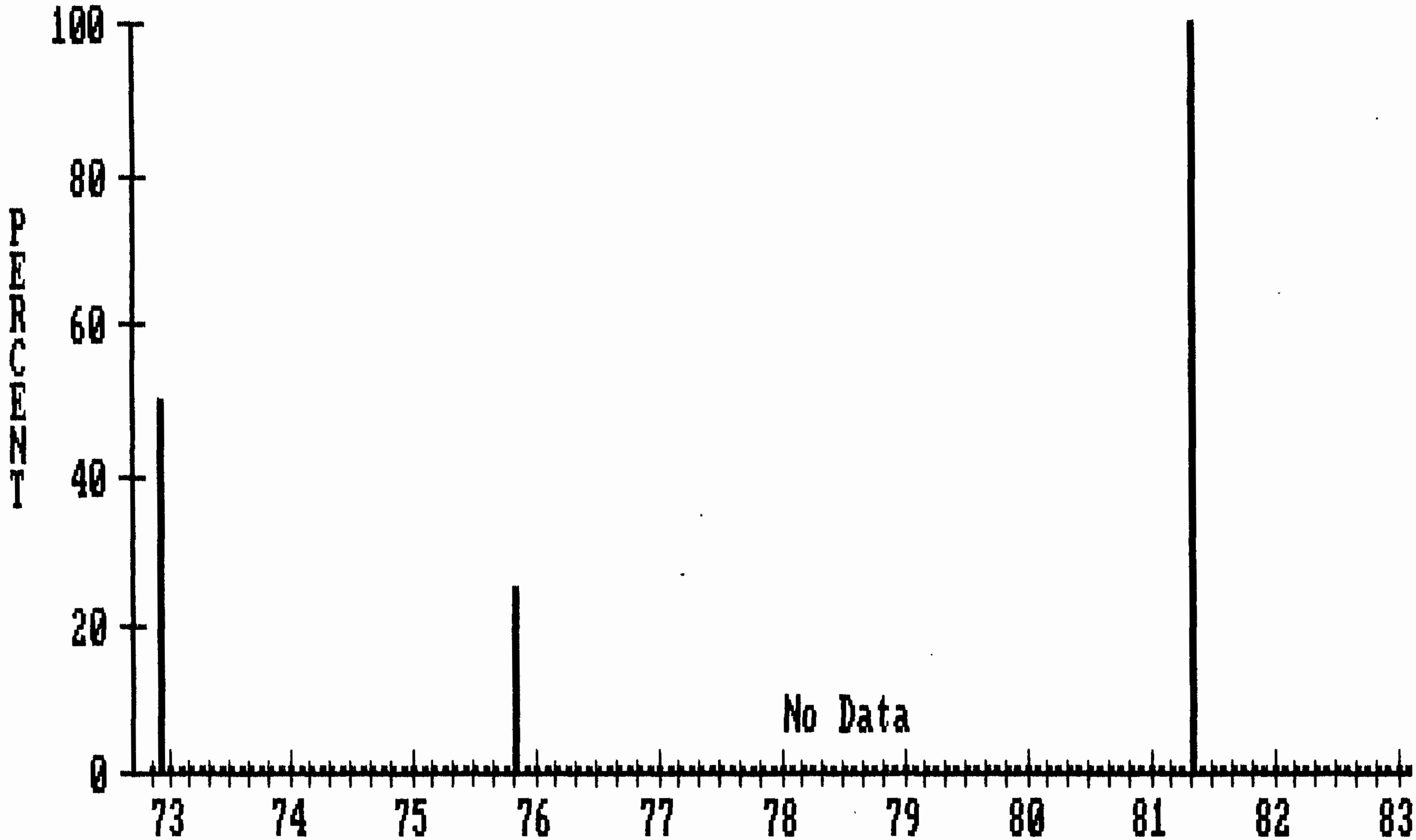
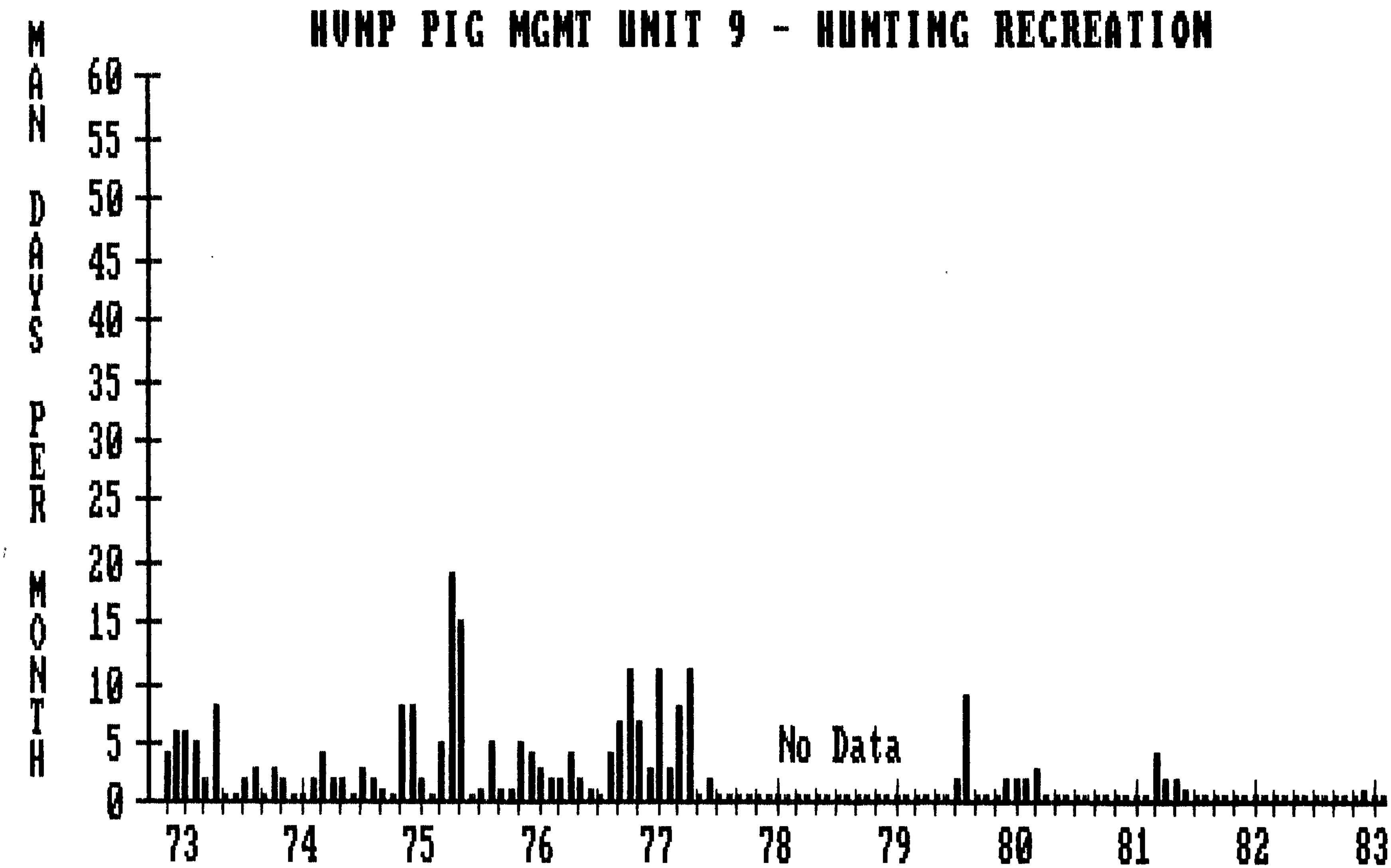
82
83


HVNP PIG MGMT UNIT 9 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
No Data
73
74
75
76
77
78
79
80
81
82
83

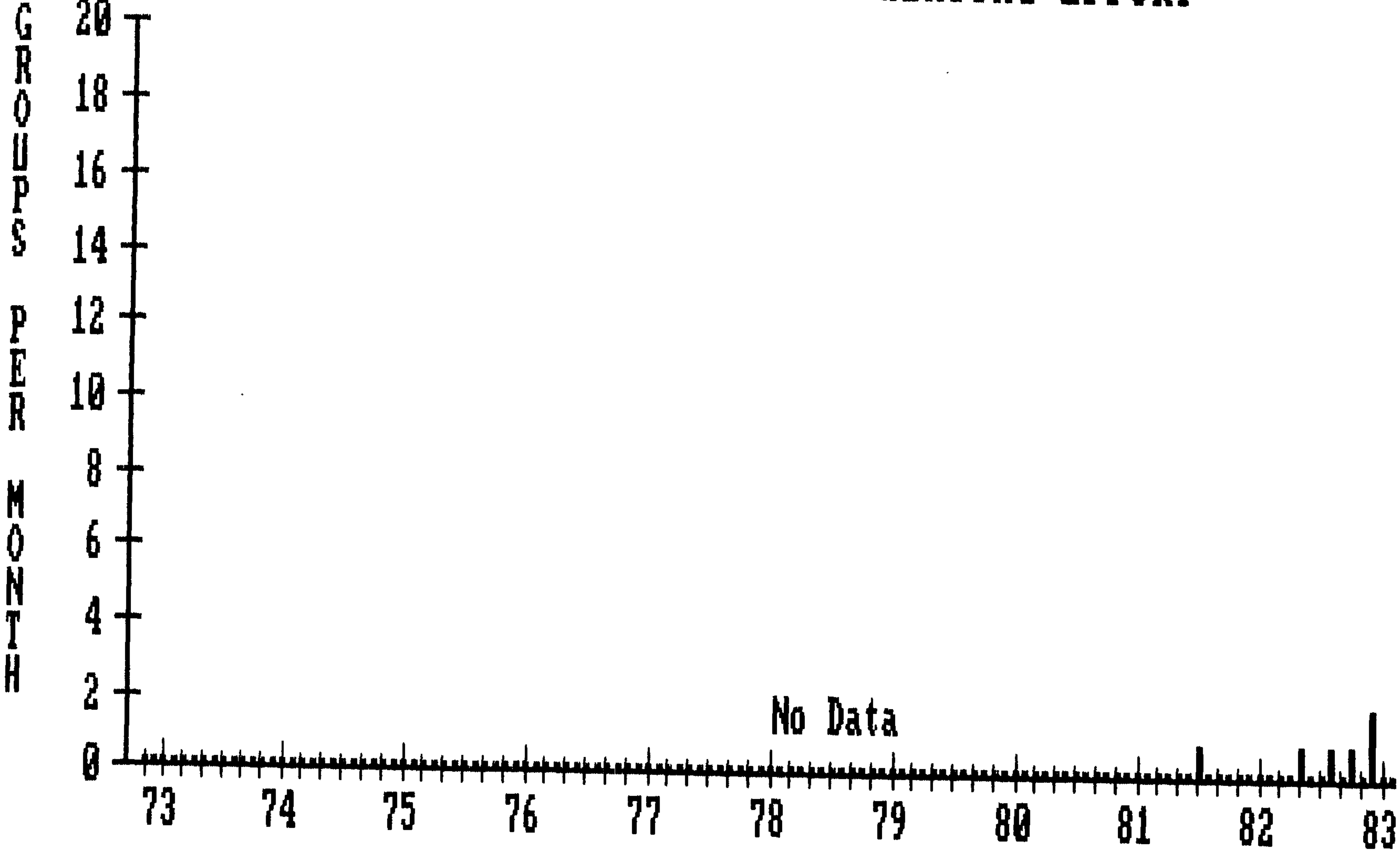
HVNP PIG MGMT UNIT 9 - GROUP SUCCESS RATE



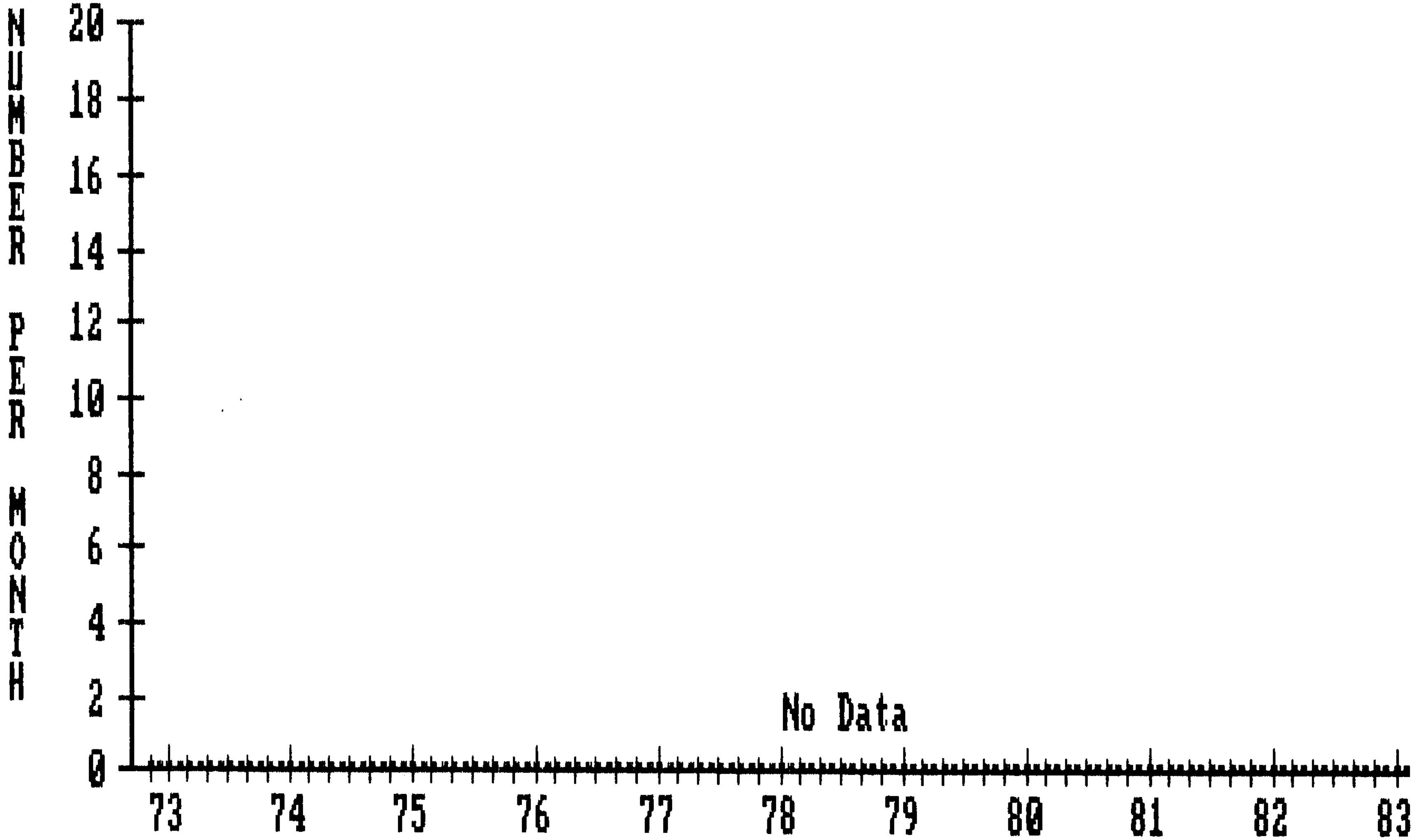


HVNP PIG MGMT UNIT 9 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83

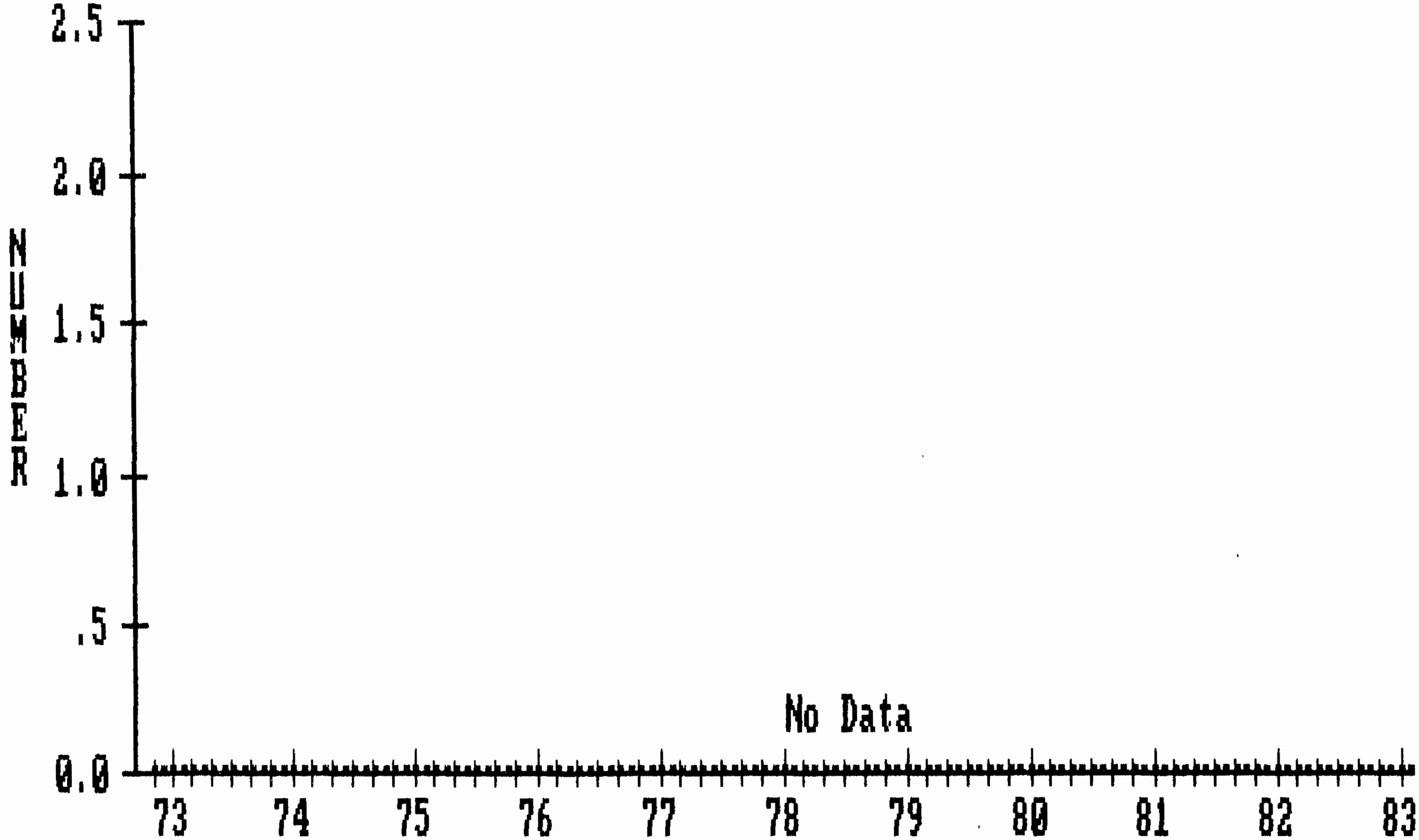
HVNP PIG MGMT UNIT 10 - HUNTING EFFORT



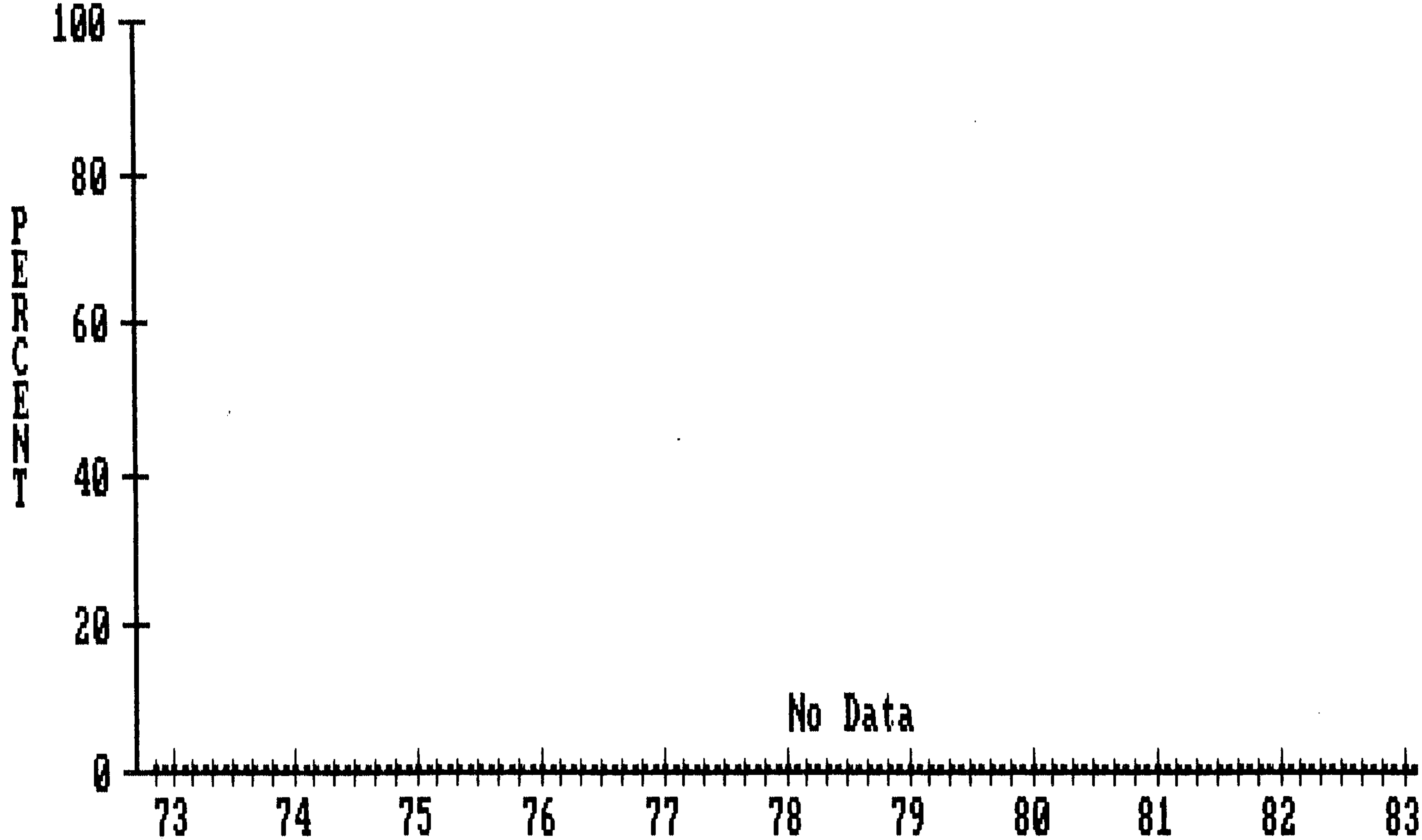
HVNP PIG MGMT UNIT 10 - RECORDED KILL



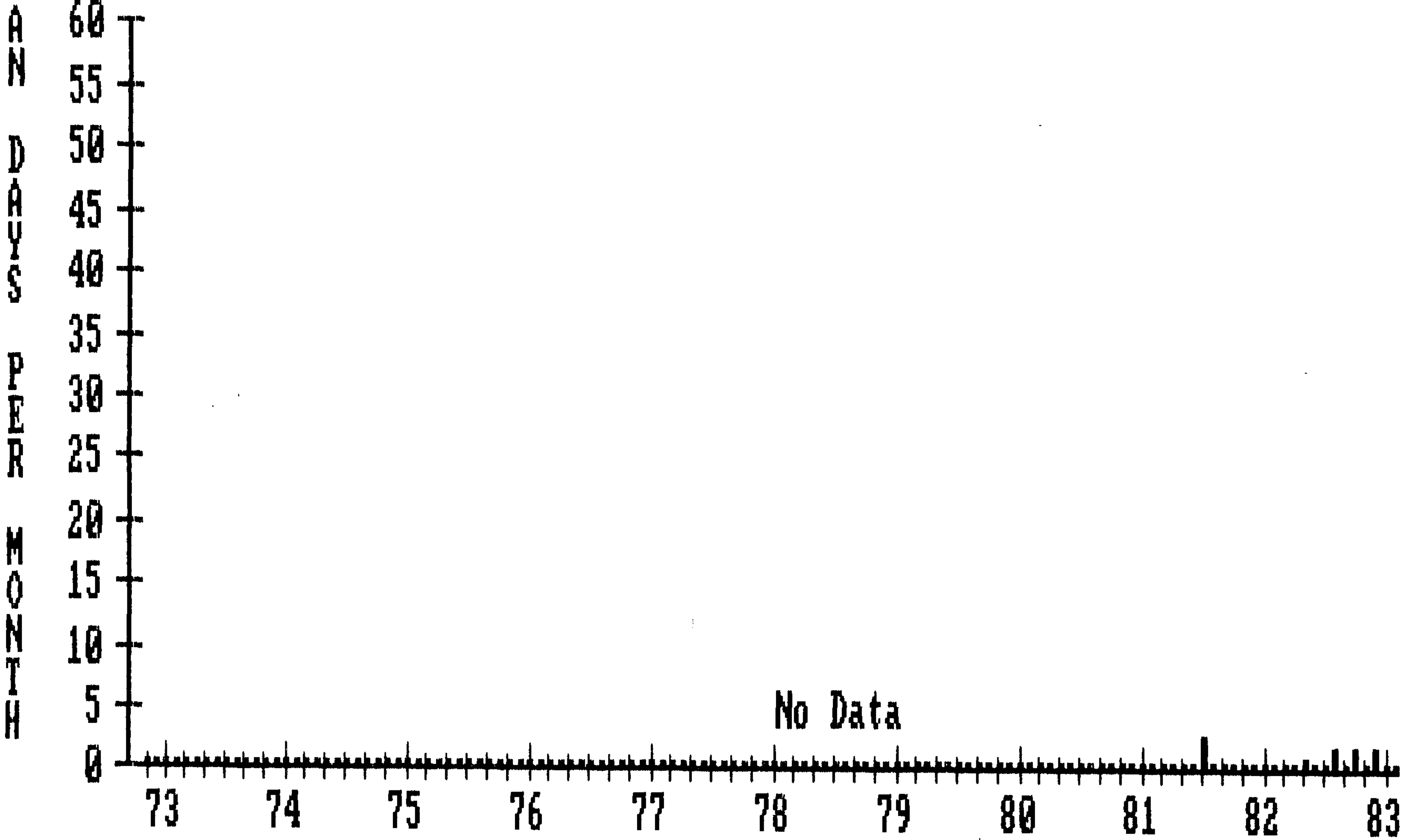
HVNP PIG MGMT UNIT 10 - MEAN PIGS PER GROUP

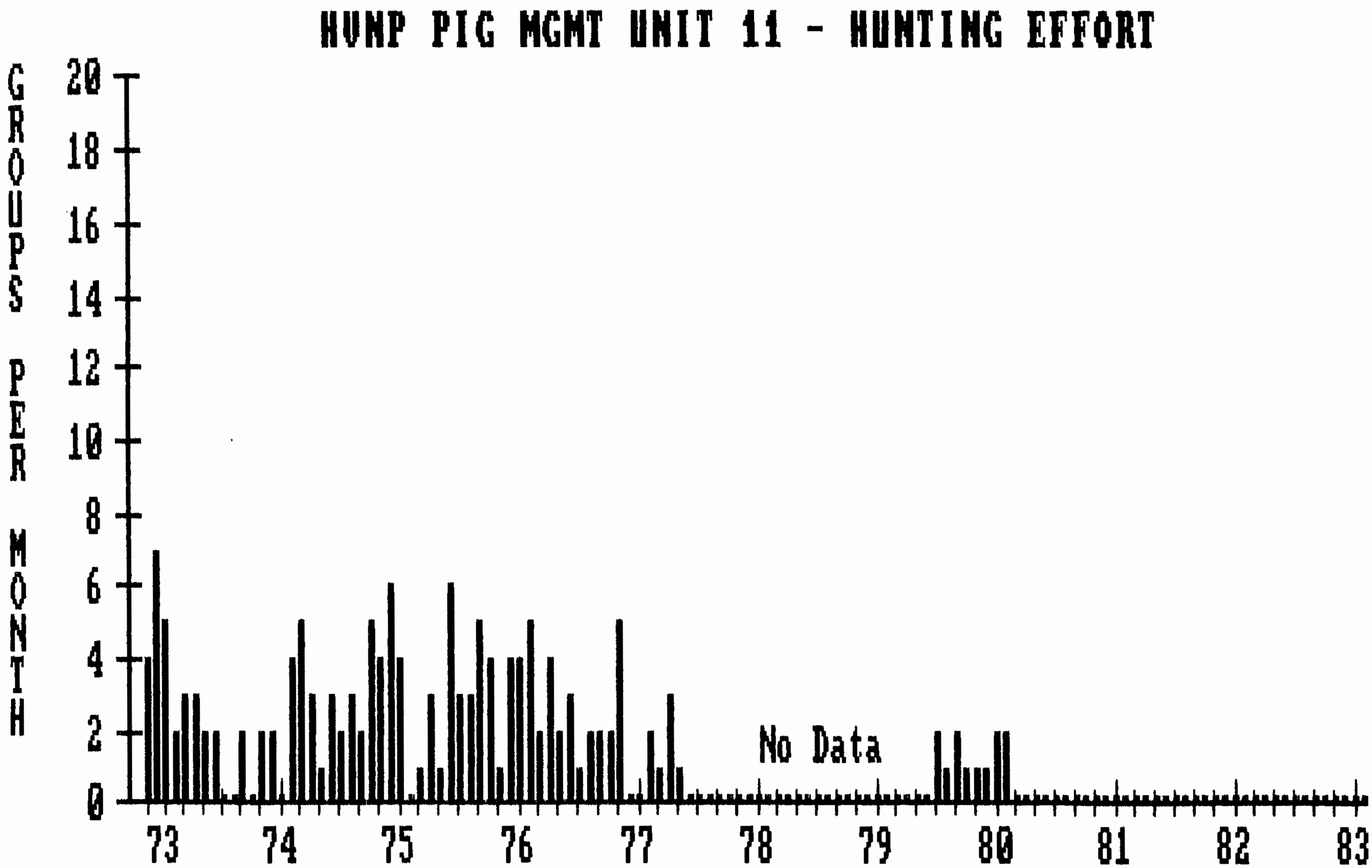


HVNP PIG MGMT UNIT 10 - GROUP SUCCESS RATE

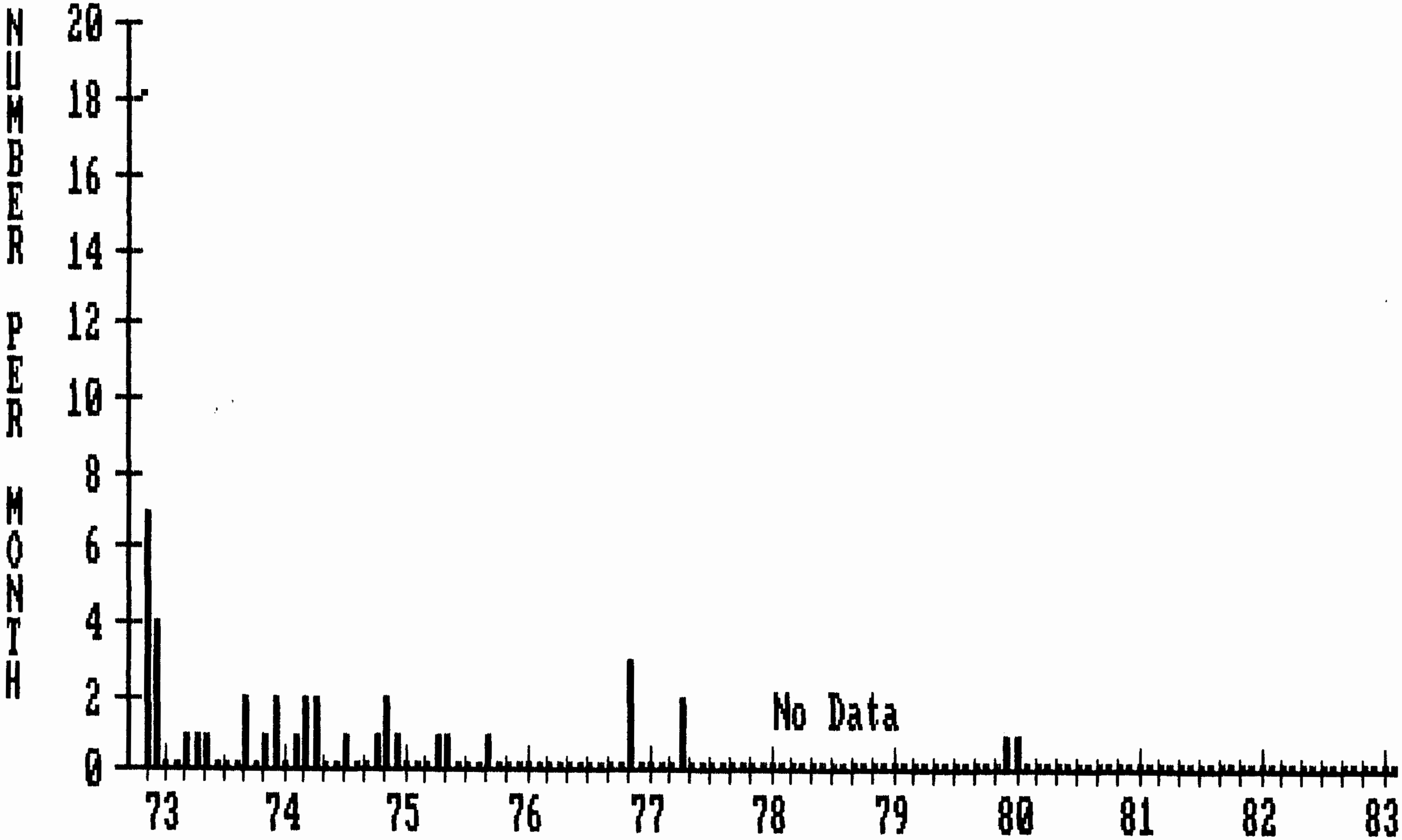


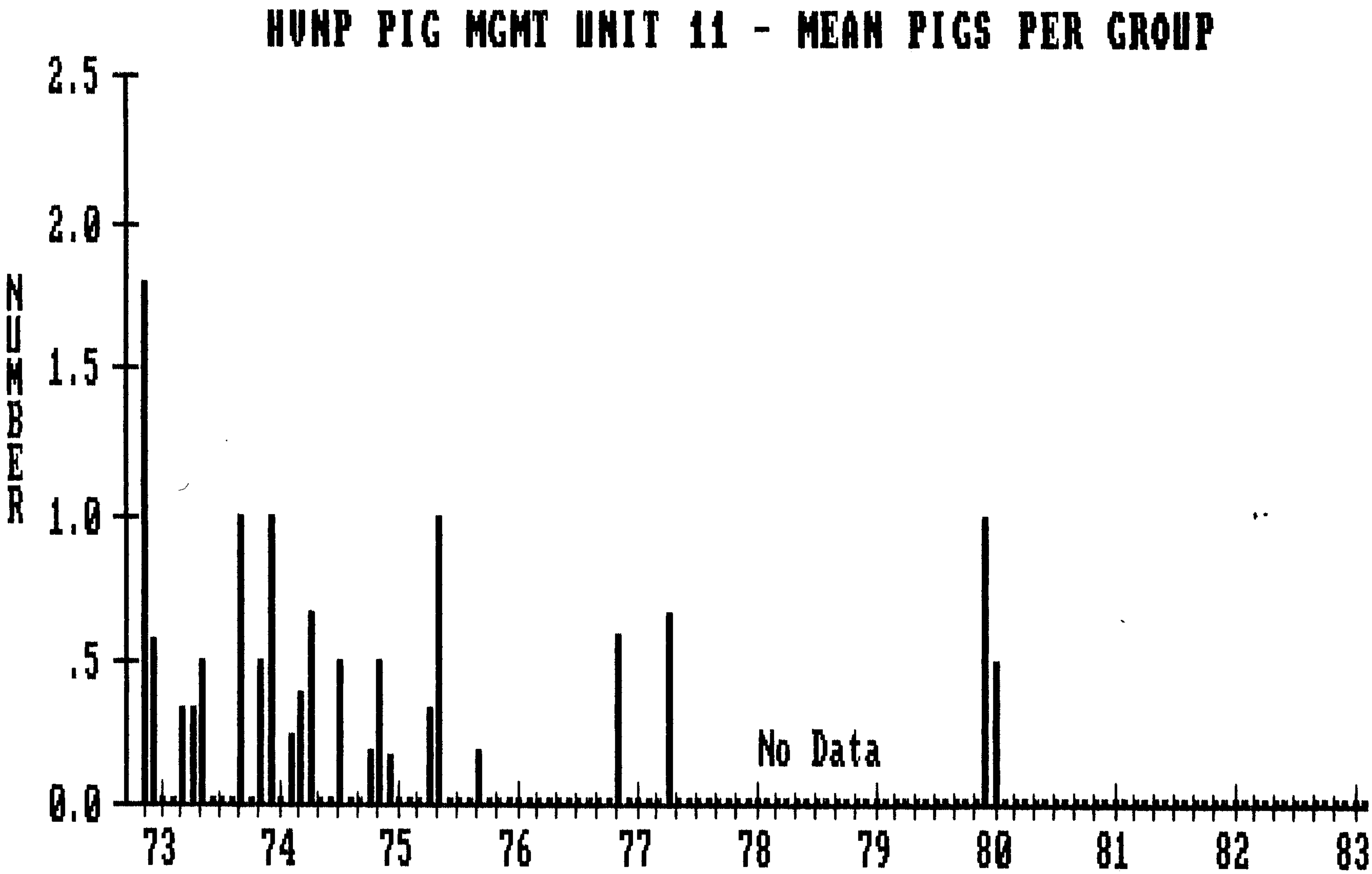
HUNP PIG MGMT UNIT 10 - HUNTING RECREATION




HVNP PIG MGMT UNIT 11 - HUNTING EFFORT
GROUPS PER MONTH
20
18
16
14
12
10
8
6
4
2
0
No Data
73
74
75
76
77
78
79
80
81
82
83

HUNP PIG MGMT UNIT 11 - RECORDED KILL




HVNP PIG MGMT UNIT 11 - MEAN PIGS PER GROUP
NUMBER
2.5
2.0
1.5
1.0
.5
0.0
No Data
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80
81
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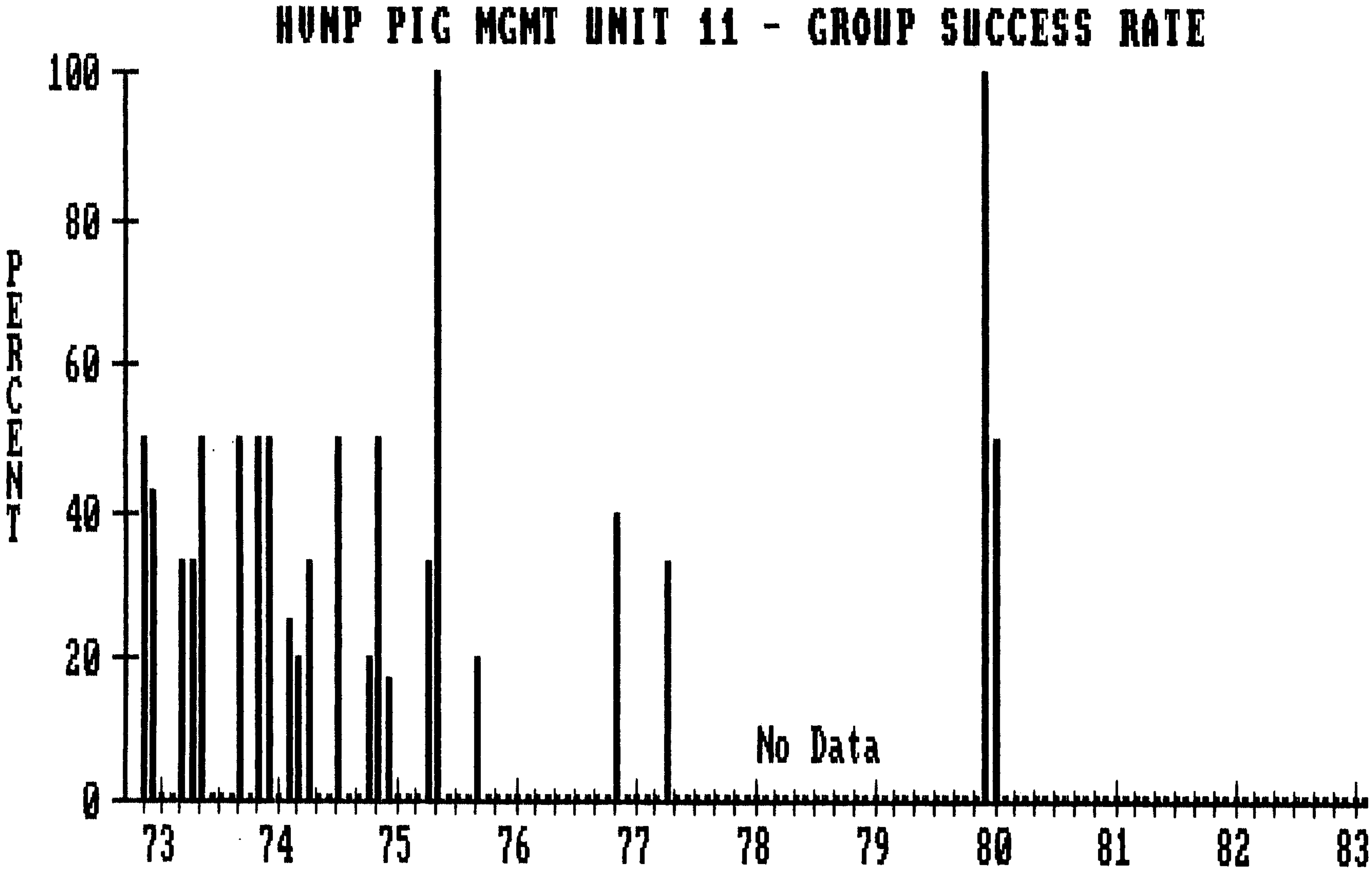
83


HUNP PIG MGMT UNIT 11 - GROUP SUCCESS RATE
PERCENT
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40
20
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No Data
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80
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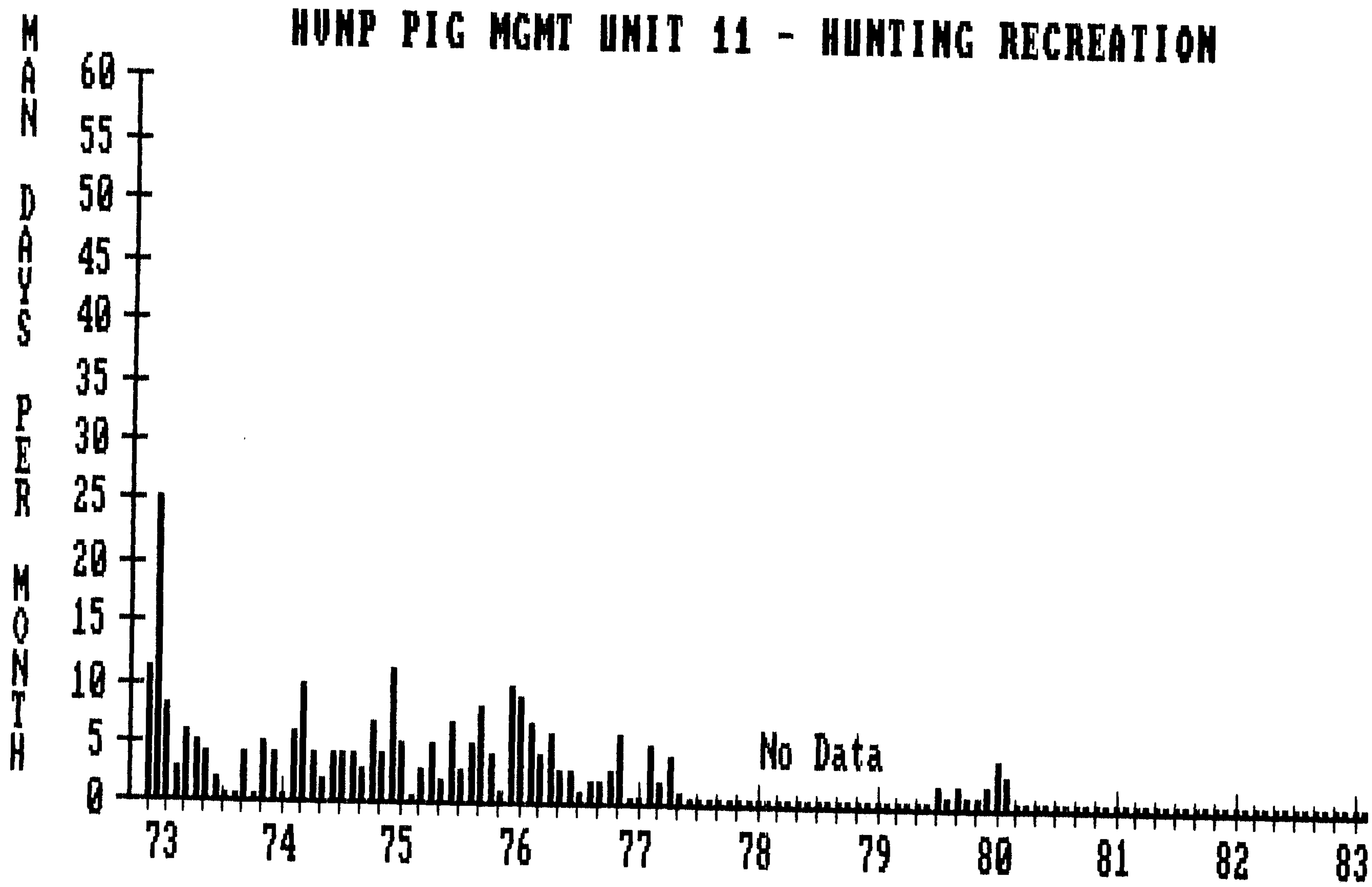
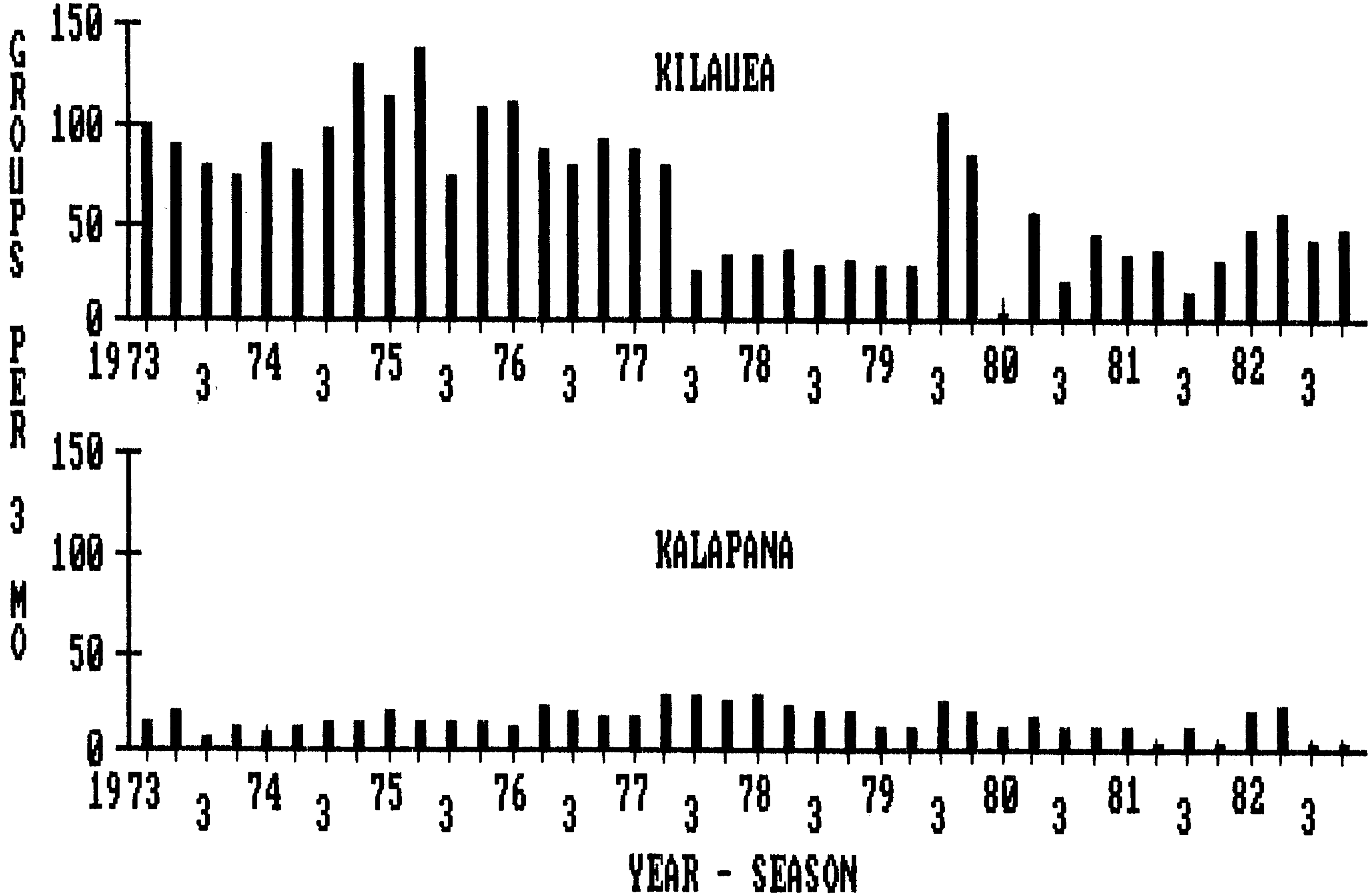
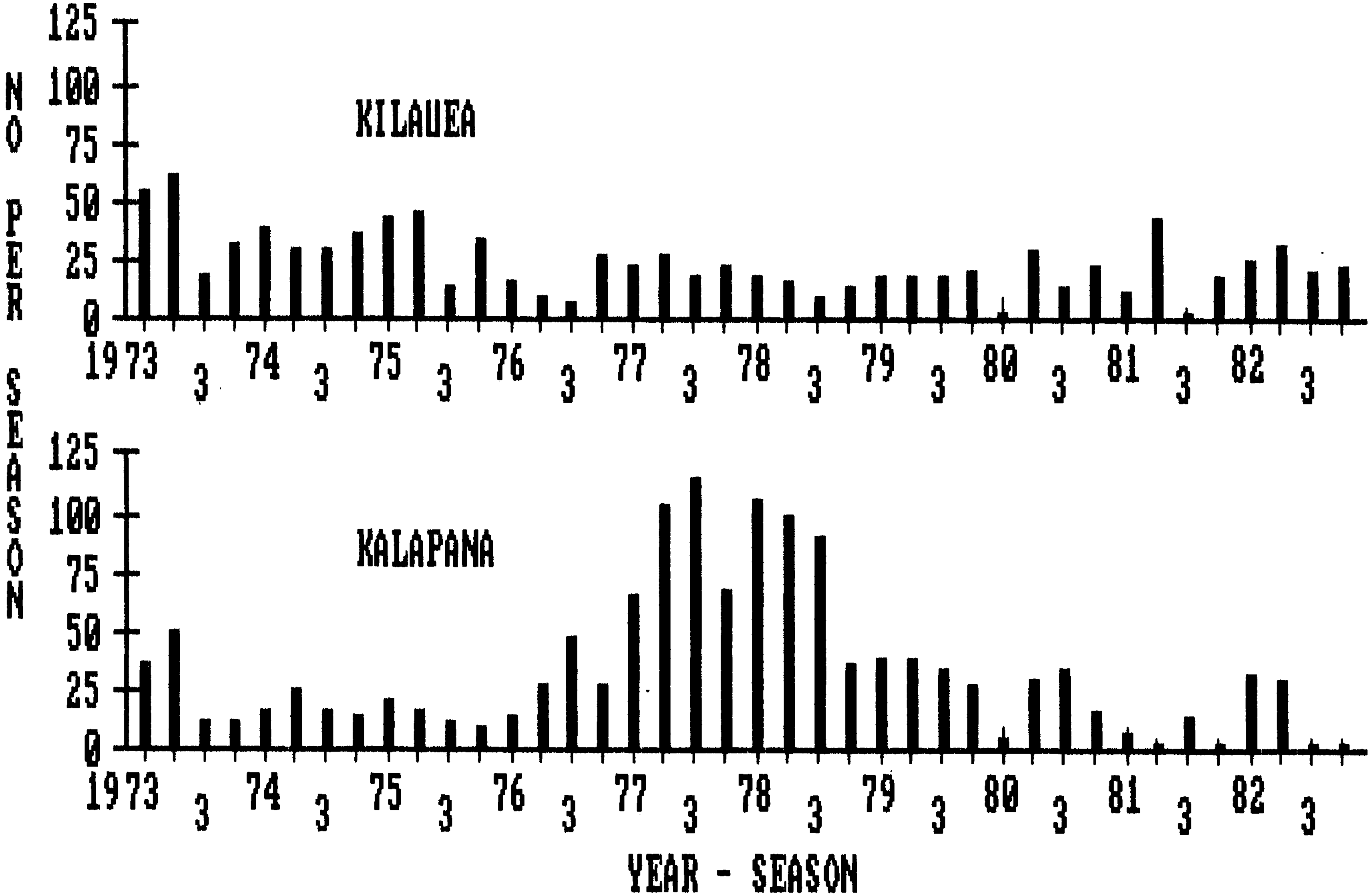
82
83

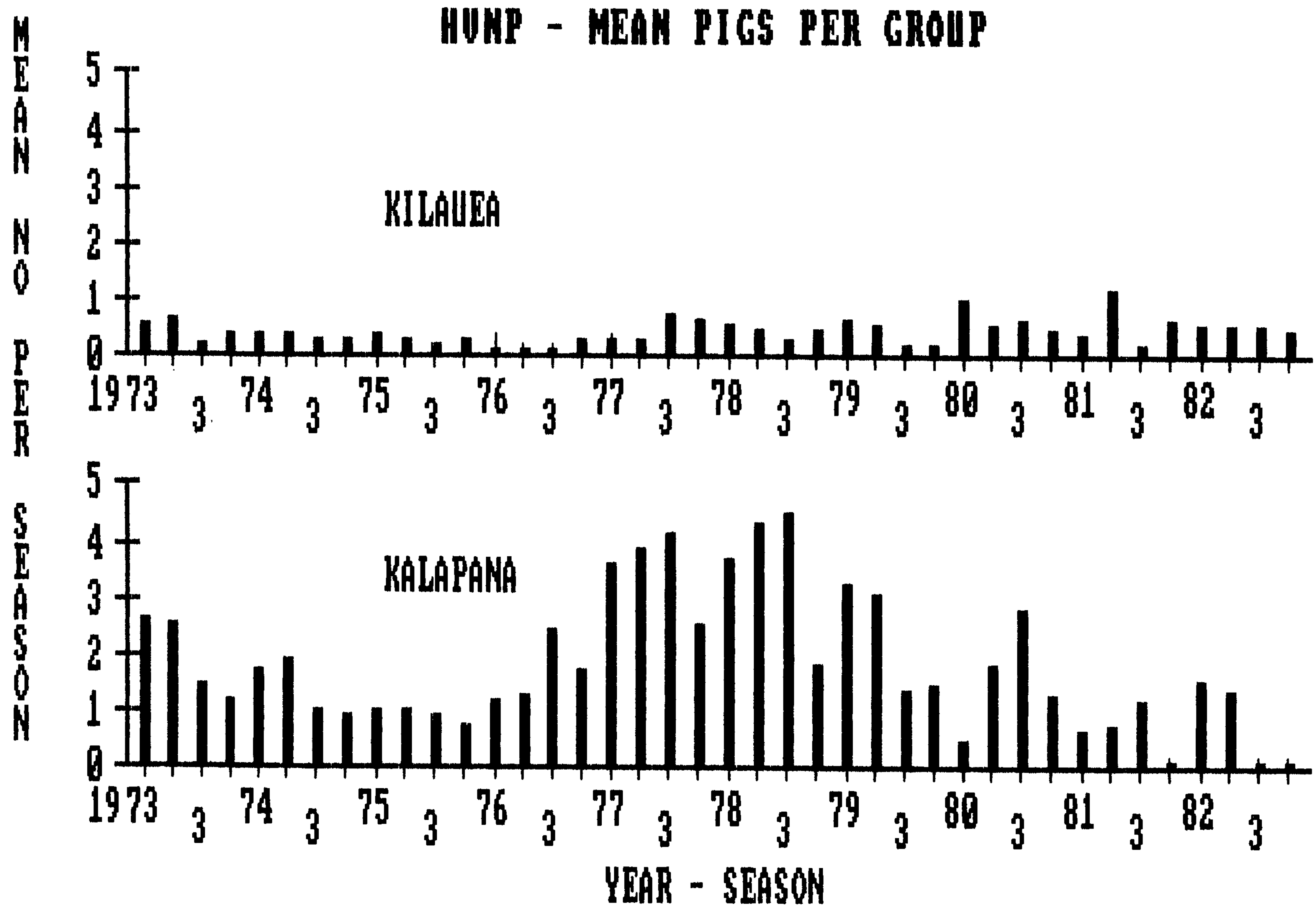

HUNP PIG MGMT UNIT 11 - HUNTING RECREATION
MAN DAYS PER MONTH
60
55
50
45
40
35
30
25
20
15
10
5
0
No Data
73
74
75
76
77
78
79
80
81
82
83

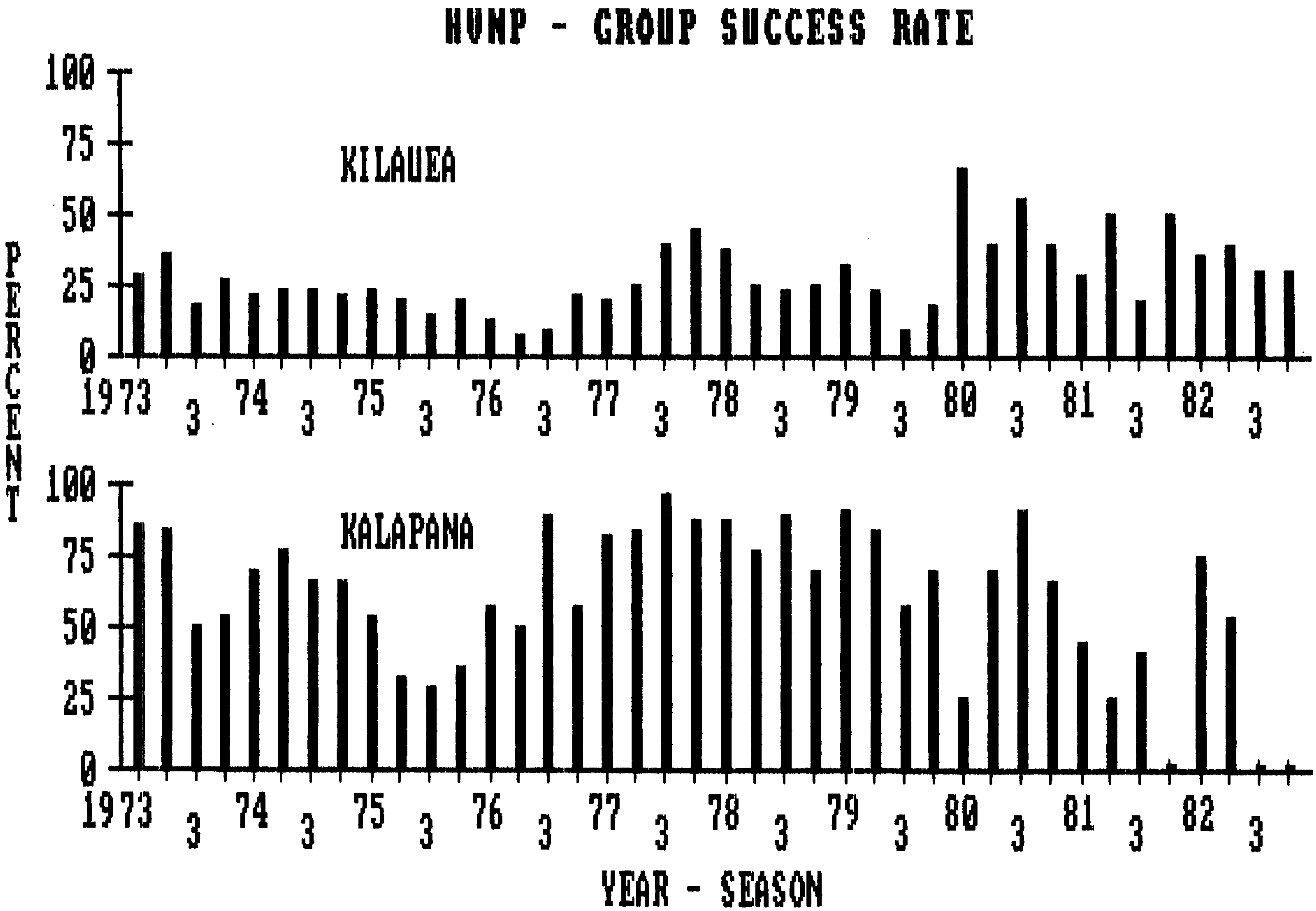
HVNP - HUNTING EFFORT

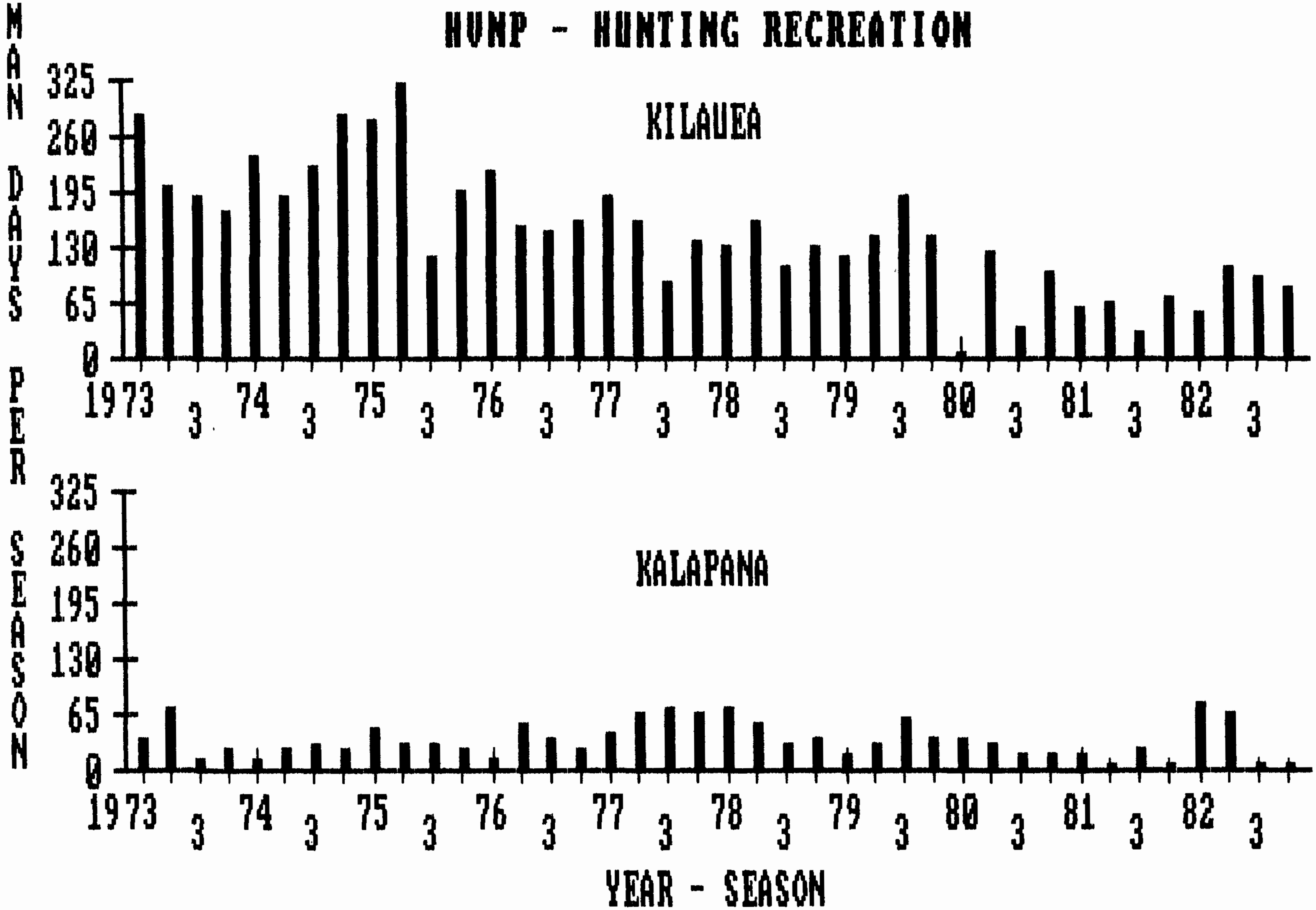


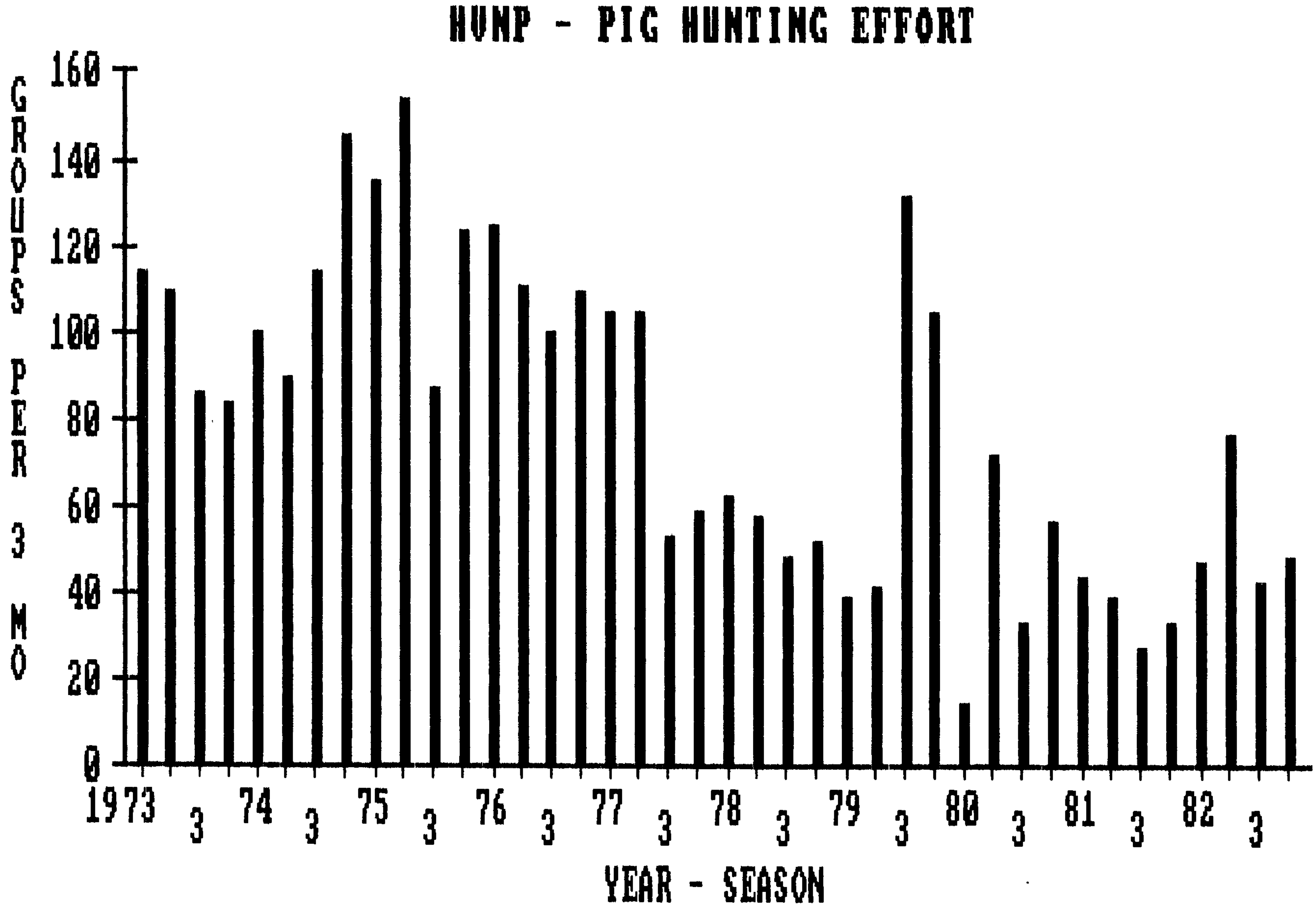
HVNP - RECORDED PIG KILL

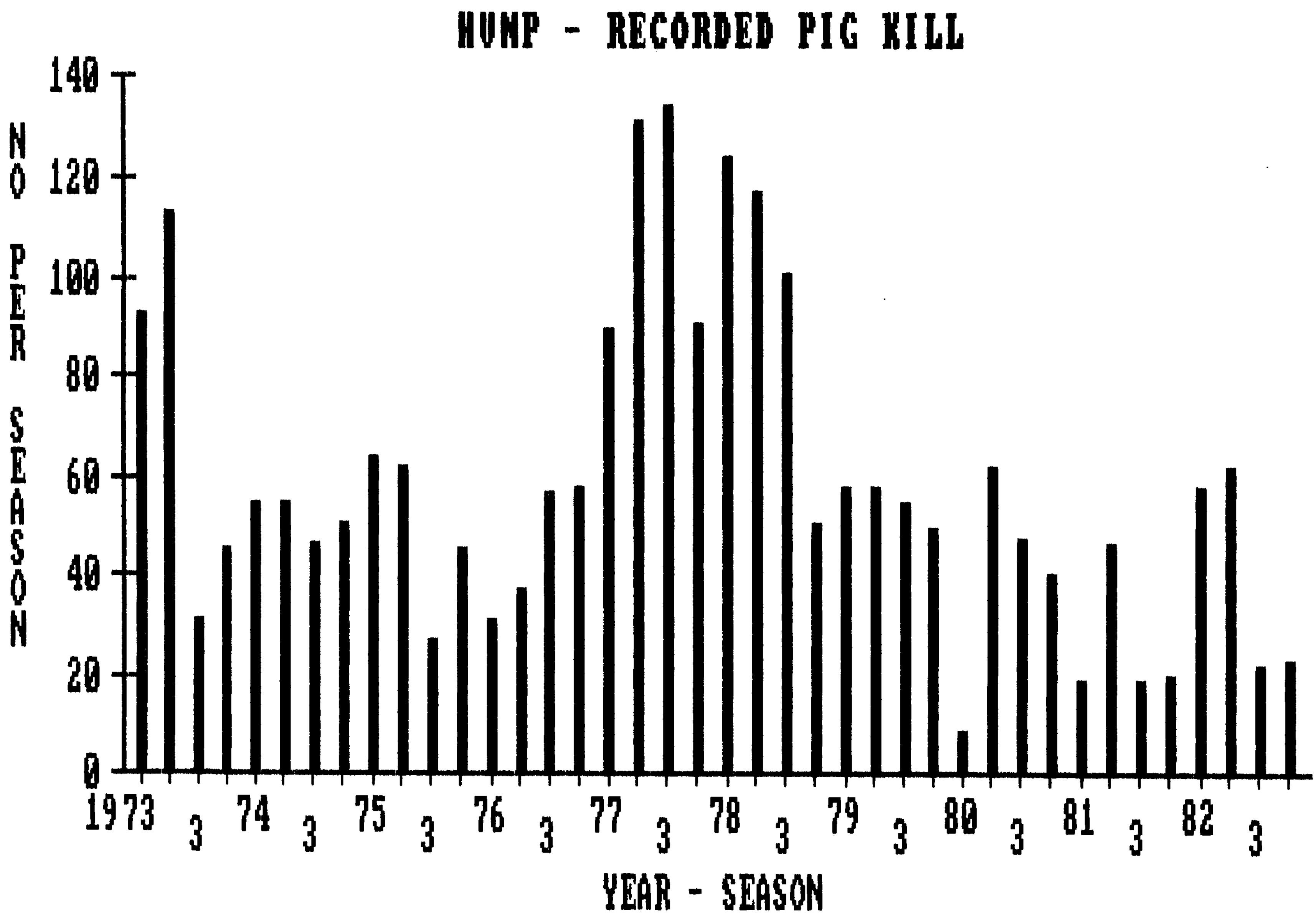



HVNP - MEAN PIGS PER GROUP
MEAN NO PER SEASON
KILAUEA
KALAPANA
5
4
3
2
1
0
1973
3
74
75
76
77
78
79
80
81
82
YEAR - SEASON

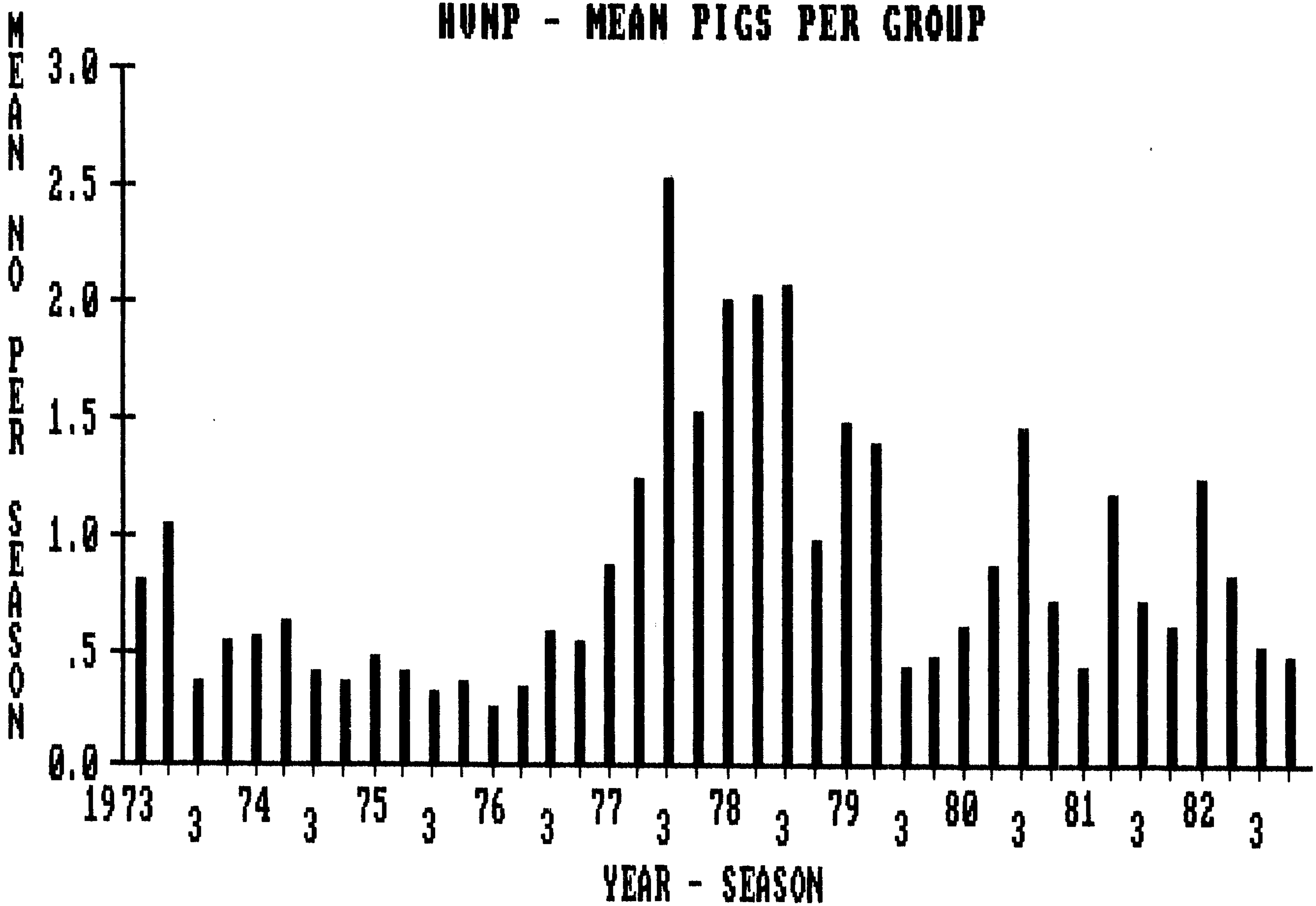

HVNP - GROUP SUCCESS RATE
KILAUEA
KALAPANA
PERCENT
100
75
50
25
0
1973
74
75
76
77
78
79
80
81
82
3
YEAR - SEASON

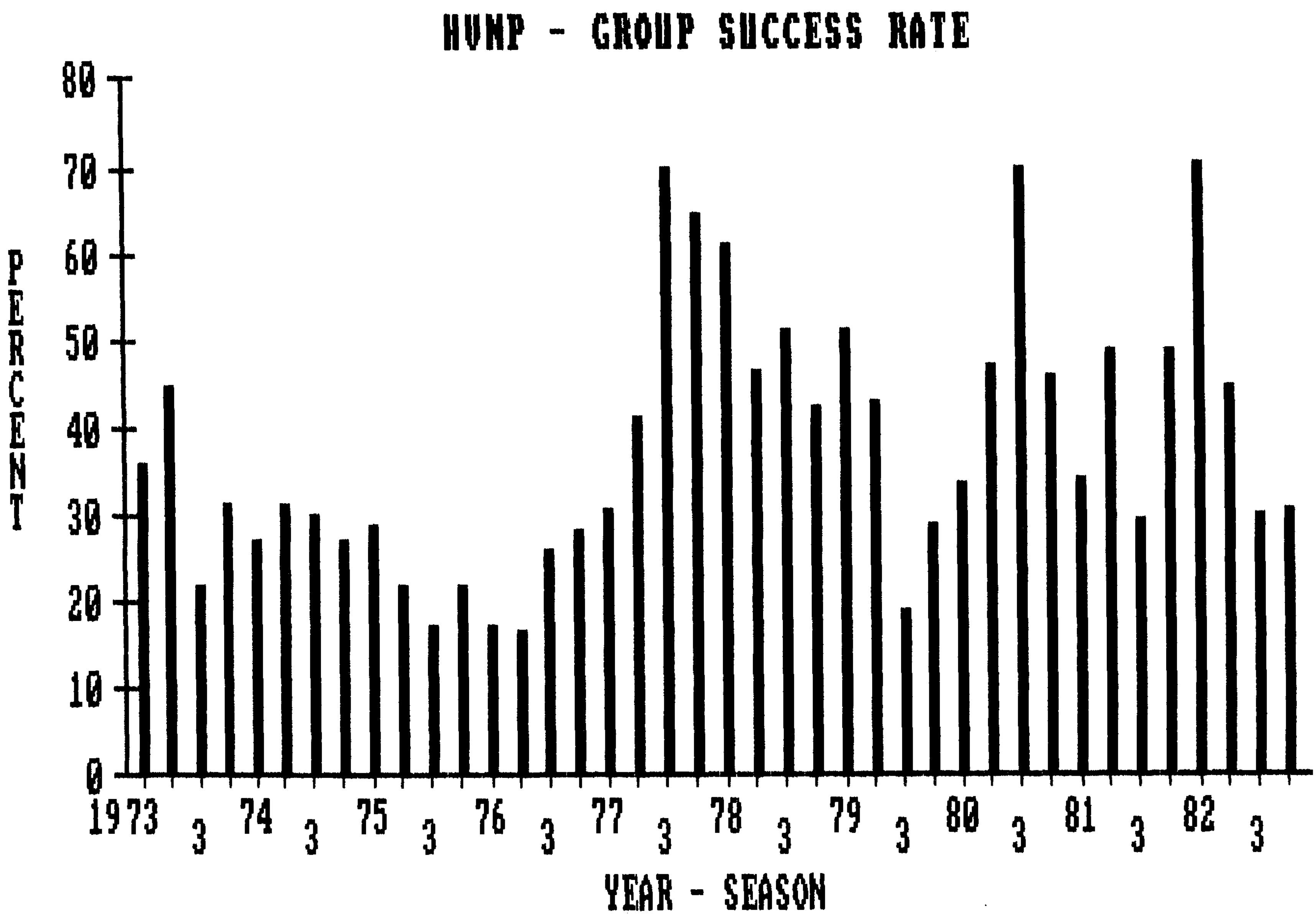

HVNP - HUNTING RECREATION
KILAUEA
KALAPANA
MAN DAYS PER SEASON
325
260
195
130
65
0
1973
3
74
75
76
77
78
79
80
81
82
YEAR - SEASON

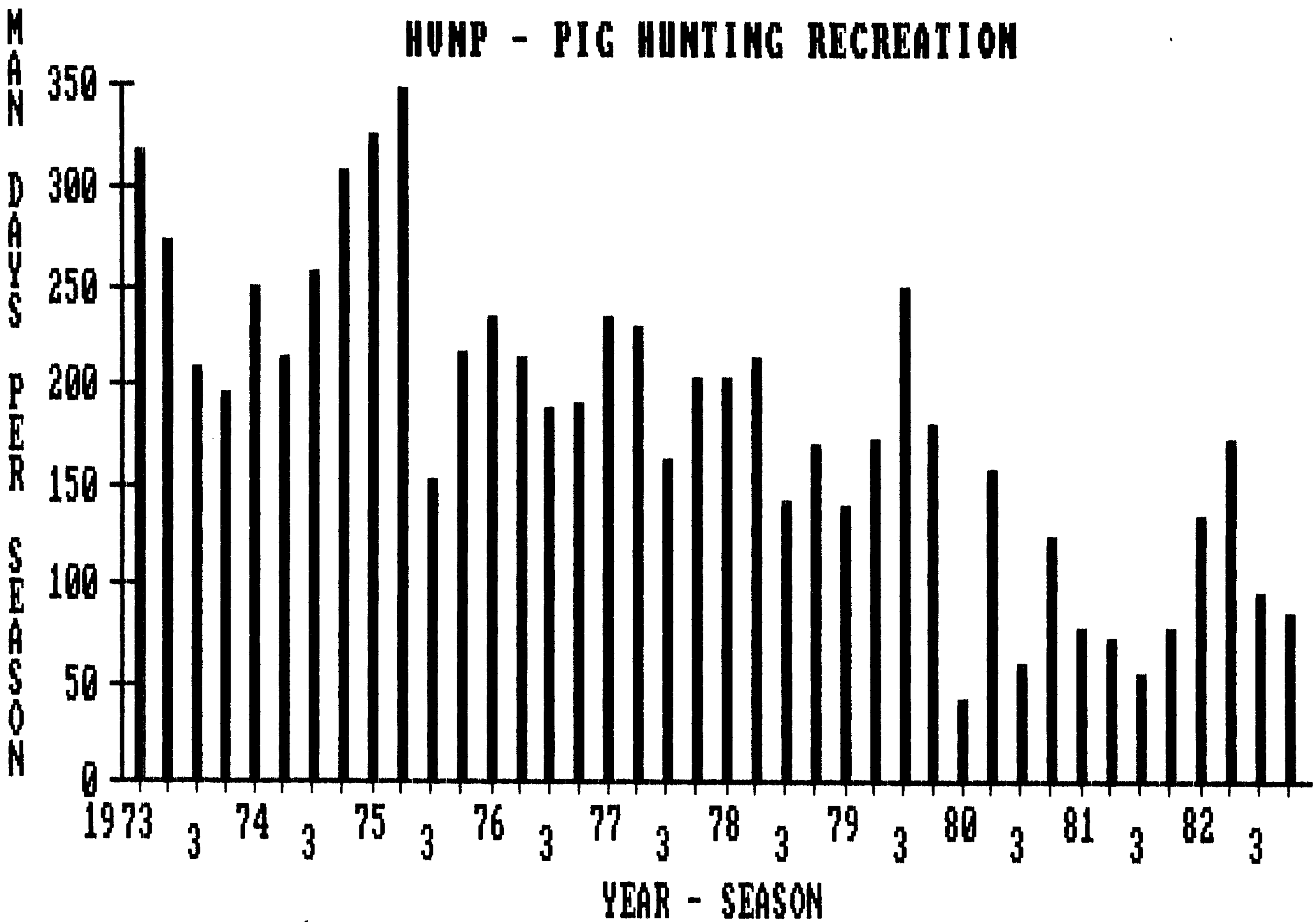

HVNP - PIG HUNTING EFFORT
GROUPS PER 3 MO
160
140
120
100
80
60
40
20
0
1973
3
74
3
75
3
76
3
77
3
78
3
79
3
80
3
81
3
82
3
YEAR - SEASON


HUMP - RECORDED PIG KILL
NO PER SEASON
140
120
100
80
60
40
20
0
1973
3
74
3
75
3
76
3
77
3
78
3
79
3
80
3
81
3
82
3
YEAR - SEASON

HUMP - MEAN PIGS PER GROUP




HVNP - GROUP SUCCESS RATE
PERCENT
80
70
60
50
40
30
20
10
0
1973
3
74
3
75
3
76
3
77
3
78
3
79
3
80
3
81
3
82
3
YEAR - SEASON


HVNP - PIG HUNTING RECREATION
MAN DAYS PER SEASON
350
300
250
200
150
100
50
0
1973
3
74
3
75
3
76
3
77
3
78
3
79
3
80
3
81
3
82
3
YEAR - SEASON